SEMINAR ON RIVER BASIN PLANNING

FT. BELVOIR, VIRGINIA

27-31 MAY 1963

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basin planning was held at Fort Belvoir, Virginia,
planning personnel of the Corps of Engineers review
all phases of the planning process with a view to e
improving and broadening each participant's knowled
standing, and developing conclusions useful for con
planning activities.

The seminar was attended full time by 73 senio
of 35 district offices, 11 division offices, the O
of Engineers, and the Board of Engineers for Rivers
There was part time participation by representative
ments of Agriculture, Commerce, Health, Education a
Interior, the Bureau of the Budget, the Federal Pow
the Council of State Governments, the Office of the
the Army, the Beach Erosion Board, and the Office o
Engineers. A roster of those participating is give

Papers were prepared on 45 topics for advance
participants. At the seminar each paper was summar
and discussed by participants. The entire range of
each day was discussed further at evening sessions
program in the appendix.

The seminar papers, with minor revisions in so
reproduced herein for the information of those conc
basin planning. While the statements in these pape
generally the practices of the authors' organizatio
were prepared as individual contributions for the p
lating discussion and analysis of river basin plann
therefore are not to be regarded as official statem
practice of the agencies with which the authors are

In making these papers available for general i
Corps of Engineers wishes to express appreciation t
others who worked with them. A limited number of c
seminar papers is available in the Office, Chief of
ment of the Army, Washington, D. C.

RIVER BASIN PLANNING SEMINAR PAPERS

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Engineering

River Basin Planning Background

Prepared for the Basin Planning Seminar, Ft. Belvo

by

Eugene W. Weber, Deputy Director of Civil Work
Office of the Chief of Engineers, Washington

The history of water resource planning in the Unit of periodic adaptation to the demands for use of water and increasing economic activity. It is characterized recognition of the multiple-use possibilities of water inter-relationship of the water and land resources with second, by consistently belated and partial action to a practices recognized as desirable. Even with the inten given to the subject since World War II and the encoura the last few years, we still lack a coordinated policy for sound river basin planning.

Schad's paper on "Perspective on National Water Re contains excellent discussion and documentation of the practices, particularly from a policy and procedural st comment and references, covering some technical aspects various sections of the country are given in the recent "River Basin Planning in the U. S.," prepared for the F conference on the Application of Science and Technology the Less Developed Areas.(2) Sources for detailed stud stone events referred to in this statement may be found of these two papers.

In the 1800's national water planning was principa purposes until the formation in 1879 of the Mississippi its dual mission of navigation and flood control. Fina Theodore Roosevelt's Inland Waterways Commission recogn prehensive plans which "...should consider and include streams may be put..." But action to permit realizatio destined to be slow in coming and piecemeal in characte

During the 1930's, the Congress authorized comprehen
all of the nation's rivers, but in 1943 refused to contin
efforts of the National Resources Planning Board to follo
liminary plans which had been drawn up by that time.

Meanwhile, Congress had provided a few more pieces o
framework of water policy by enacting the Flood Control A
and 1944. Under this legislation planning and developmen
more multi-purpose and was often basin-wide. This era wa
of inter-agency action on water planning.

After World War II, intensive policy formulation act
out under two Hoover Commissions and two Presidential Wat
but very little official water policy action resulted fro
though they helped to crystallize Federal agency policies
many respects. Of greater practical effect in the 1950's
of the Federal Inter-agency report on "Proposed Practices
Analysis of River Basin Projects" which, though never for
the agencies, was nevertheless put into practice, at leas
agencies concerned and brought about considerable improve
lation and evaluation of water plans. Congress got into
act also with the Jones Public Works subcommittee reports
specific legislative action was taken on the basis of the
reports.

In the fifties also, there were undertaken the first
ments in comprehensive basin-wide planning on an inter-ag
Arkansas-White-Red effort has been evaluated by Fox and P
"time consuming, cumbersome and costly process" which fai
ordinated plans largely because of a lack of definite obj
applicable alike to all participating agencies. The New
inter-agency effort was similarly handicapped.

The recent reports of the Texas and S. E. Study Comm
reflect, to a degree at least, the most recent improvement

Under the accumulated weight of the numerous but co
declarations of the fifties, the improvement in standard
formulation and evaluation, the experiments in inter-age
addition of a few more pieces of policy legislation, the
set in 1960 for real progress towards the type of river
gested by the Inland Waterways Commission in 1908 and by

Congress, which had often professed belief in comp
seemed to prefer to authorize individual projects and to
case by case, provided one of the most effective steps
water planning in the form of the report of the Senate S
National Water Resources. This report, with its perspec
water needs of the next few decades, has provided a use
water planners. Federal and non-Federal interests gener
the desirability for action on its recommendations and
has been made in the last two years, particularly on re
programs and, to some extent, on basin planning.

President Kennedy, in his February 23, 1961 Message
endorsed the Senate Select Committee report generally a
promised action on basin planning. The nature and curre
resulting actions since 1961 are of particular signific
and will be explored more fully than the earlier develop
referred to only briefly.

In July 1961, the President proposed a "Water Reso
1962" which was introduced in the Senate as S. 2246 and
H. R. 8155 and 8177. The proposed act provided for a Wa
of four Secretaries, authority for Presidential appointm
Commissions and a program of financial aid to States fo
Hearings were held jointly by the Senate Interior and Pu
at which opposition was expressed particularly to the i
sions and to their proposed composition. Consultation
and opposition interests, primarily through the Council
during 1962, produced some proposed amendments which ha
into a proposed "Water Resources Planning Act of 1963"

for uniform application by all agencies. As you know these by an Interdepartmental Staff Committee, reviewed by others constituent Departments, recommended by the four Secretarie approved by the President on 15 May 1962. With the approva standards, which were printed in S. Doc. 97, Budget Circula 31 December 1952 was rescinded and the President requested taries to continue studies to develop recommendations on co cost sharing and reimbursement policies which were not cove standards. On 31 May 1962 the President reiterated this re for special attention to standards for recreation benefit e for flood protection cost sharing. Good progress has been benefits and formal action may be possible within a few wee There is reasonable agreement on possible minor variations protection cost sharing principles but because of the likli reluctance to legislate any change, it is not clear whether this subject will be forthcoming in the near future.

On cost allocation, there has been considerable discus progress though recently there are indications that the eff of the new standards to the cost allocation process may eli differences of opinion concerning present allocation practi vented formal inter-agency recommendations on this subject.

On cost sharing and reimbursement, there has been prog limited areas such as for flood protection and on possible recreation. On the latter subject, cognizance should be ta tion by Executive Order 11017, 27 April 1962 of a Recreatio consisting of the Secretaries of the Interior, Agriculture, Education and Welfare, and the Administrator of the Housing Agency; the establishment of a Bureau of Outdoor Recreation of Interior, with a mission to coordinate Federal recreatio serve as a staff to the Recreation Advisory Council; and th proposals for a Land and Water Conservation Fund introduced year as S. 859 and H. R. 3846. The Senate bill has been re Committee favorably and the House version is currently unde

Second, the standards stress a long-range view
ation of future needs for water and equal consideration
analyzing the physical possibilities for meeting such n
purpose is arbitrarily placed in a secondary or inciden
plan formulation is concerned as, for example, recreati
Circular A-47 and water supply was until the legislatio

Third, plan formulation and evaluation are to
ples based initially on tangible values with departures
monetary terms clearly outlined when intangibles are gi

Fourth, they call for outlining alternative so
ation of higher authorities when factors involving judg
policies, intangibles, etc., may warrant departures fro
a monetary basis.

These new standards, together with recent developm
Pollution Control Act Amendments of 1961 relating to st
regulation for water quality control, the water supply
the Fish and Wildlife Coordination Act of 1958, and the
by the Executive and Legislative Branches of the need f
purpose planning have removed many if not most of the c
administrative regulations that have precluded or at le
preparation of fully comprehensive plans for the nation
still do not have a precisely definitive body of law an
of uniform interpretation and application by all concer
so many significant positive actions favorable to effec
much elimination of constraints to good planning that w
that we can produce plans that will meet obviously emer
can expect the public, the Congress and the President t
improvement of the basic ground rules. We must do this
minimum cost or we may expect a reaction and a withdraw
acceptance of some of the enlightened policies and prac
few years.

What have we done on basin planning since the 1961

a position to suggest that, pending possible establishment o
mmissions as proposed by the President, comprehensive, inter-
anning could proceed along lines of the recent Delaware Basi
ing a tentative schedule of proposed comprehensive studies fo
sins and sub-basins at an estimated cost of $175 million prep
rps, the Interdepartmental Staff Committee undertook to coor
anning programs of Interior, Army, Agriculture and HEW for fi
e interdepartmental group took cognizance of agency plans for
anning efforts beyond the amount that would be done by those
nds to be transferred from Corps' appropriations. An allowan
se on the order of $50 to $60 million had been made in the te
timate of $175 million, based on experience in the Delaware a
udies. The interdepartmental estimate, which was submitted t
the four Secretaries on 27 November 1962, indicated that the
mpleting comprehensive plans for all of the nation's rivers w
der of $400 million. As will be discussed more fully by Gene
der "Recent Developments", these estimates of ultimate total
de comprehensive planning have caused considerable concern du
deration of the 1964 budget by the committees of the Congress

Several changes in organization have been made recently th
gnificance to our basin planning efforts.

In recognition of the increasing complexity of our Civil W
o additional Deputy Directors of Civil Works have been named
p level attention to formulation of policies, coordination wi
d guidance in comprehensive basin planning.

The Planning Division of Civil Works is being expanded to
ility of OCE personnel to work more closely and more frequent
eld offices on planning, particularly on economic aspects and
end of each major comprehensive planning effort.

In field offices, basin planning branches are being establ
ssistant Chief for Planning set up in the Engineering Division
ersonnel are being added, particularly in special skills, as a
work load and availability of funds.

North Central Division supervised a concept contra
of Minnesota to formulate an intensive 8-week course ex
planning personnel. Though Minnesota cannot start such
as had been hoped, the concept formulation work is bein
a course started at the University of Illinois.

Meanwhile, the University of Kansas is considering
intensive 8-week course in water planning which would b
Also, inter-disciplinary seminars, graduate courses and
for education and training in water resource planning a
several universities around the nation. We are coopera
plan to participate regularly through the Army Fellowsh
detail of planning personnel for resident graduate stud

Field offices have utilized many forms of improvin
of existing and prospective planning personnel. During
hope to obtain more information on this subject both wi
Corps and to organize our Corps-wide participation for

In research, we have continued to support the Harv
through consultation with several schools have outlined
research projects related to planning but unfortunately
not provide for expansion of effort along these lines.

In summary, the background and developments outlin
after many years of slowly developing recognition of th
purpose, basin-wide planning and piecemeal accumulation
necessary legislation and administrative policy to make
it is now essential that the Corps adapt its policies,
to take a leading part in a realistic program of basin-
events of the last few years have set into motion many
right direction. Whether we will now move off in that
a walk or a fast trot depends more on the reaction of t
than on our willingness and ability to do the job. We
this under "Recent Developments" next on the program.
ever rate we are asked or permitted to prepare basin pl
is given to the plans we are asked to prepare, the prin

List of Corps' actions pertaining to basin planning.

1. Letter of 23 June 1961 from Chief to all Division
putting emphasis on broadened perspective for water resourc

2. Letter of 17 July 1961 from the Director of Civil
Division Engineers setting a 4½ percent economic growth goa
of projections used in planning for comprehensive developme
purpose river basin plans.

3. Letter of 17 July 1961 from Chief to all Division
questing that basin plans be formalized, reviewed and updat

4. Conference in OCE during week of 7-11 August 1961
representatives of division offices at which time matters p
preparation of basin plans were among subjects considered i

5. Letter of 28 August 1961 from the Director of Civi
Division Engineers requesting submission of river basin pla
report form to reach OCE not later than 1 October 1961. Re
for some 200 basins were received in response.

6. Letter of 19 December 1961 from the Director of Ci
all Division Engineers requesting that the Division Enginee
a member of his planning and reports staff to be responsibl
basin planning in the Division and scheduling a conference
River Basin Planning.

7. Conference in SWD on 1-2 February 1962 attended by
of Planning and Reports Branch of Division offices at which
basin planning concepts and techniques were considered in d

8. Letter of 14 May 1962 from the Director of Civil W
Division Engineers requesting Division staffing and funding

10. Letter of 11 June 1962 from Director of Civi
Division and District Engineers emphasizing the import
hensive planning in the programming for long-range and
resource development.

11. Letter of 15 June 1962 from OCE to Division
neers transmitting for Corps' use, the new "Policies,
cedures in the Formulation, Evaluation, and Review of
Development of Water and Related Land Resources." (S.

12. Letters of 15 June 1962 from ASA (FM) to Sec
culture, Interior and Health, Education and Welfare su
of the four Secretaries designate a representative to
suggestions of the Budget Director and calling for a r
designated representatives on June 25, 1962.

13. Letter of 2 July 1962 from the Director of C
Division Engineers requesting that cost and scheduling
prepared as a basis for a preliminary summary study so
the general magnitude of the task of meeting the Admin
planning goal and calling for Division planning chiefs
to OCE during the last week of August 1962.

14. Series of conferences in OCE during the peri
1962 attended by Division planning chiefs at which the
for basin planning were reviewed and correlated.

15. Corps of Engineers' tentative overall progra
dated October 1962 developed from data submitted by Di

16. Letter of 27 November 1962 from four Secreta
comprise the proposed Water Resources Council, to Mr.
coordinated budget for FY 64 water resource planning p

17. Letter of 28 January 1963 from the Chief of
Division Engineers relative to the establishment of ar

COMPREHENSIVE BASIN PLANNING, RECENT DEVELOPMENTS

by
Brig. General Howard W. Penney
Deputy Director of Civil Works for Comprehensive Planni
Office of the Chief of Engineers, Washington 25, D. C

The most significant recent developments concern co
prehensive plans. On 15 March 1963, the Chairman of the
on Public Works of the Senate Appropriations Committee w
Director of the Bureau of the Budget expressing concern
cost of comprehensive studies budgeted by the Department
Year 1964 (pages 13 and 14). This was later reflected
appropriations hearings in both the Senate and House fo
Departments. The letter stated that it would appear tha
use of all the agencies that have been engaged in this
years, together with a realization that of necessity ou
the needs 50 to 100 years from now is so sketchy, a high
refinement in each individual phase of comprehensive stu
be unjustified. It suggested that the Budget Bureau sta
with the agencies with a view to developing a more reali
to formulation of basin plans. The Bureau of the Budge
each department that the questions posed by that letter
the need for a careful review of each agency of the plan
that guide its basin planning effort (page 15). The Bu
a partial response to Senator Ellender on 23 April 1963
21).

The Corps at this time developed a concept for revi
scope and cost of the comprehensive basin studies (page
The purpose was to reassess the extent and degree of re
really needed in comprehensive studies. The concept in
into the draft an interdepartmental recommendation to BO
to the Appropriations Subcommittee's letter, and was us
the budget requests at our appropriations hearings (als
memo of 7 May 1963, pages 25 & 26).

which projects the needs; to hydrologic studies a
related land resource availability which establis
meeting those needs in terms of regulation, contr
water and related land resources; and, as a maxim
of a general plan of development.

d. For the rest of the nation, we conc
prehensive planning will be on an individual rive
basin basis, as the requirements of the region re

e. Comprehensive individual river or t
plans should provide (1) a sound basis for necess
near-future action programs, including constructi
appraisal of longer-range water and related land
ment needs as a general guide to future planning
grams, including construction. In order to accom
jectives in an orderly and efficient manner, thes
basin plans must (1) identify the general nature
resource development needs for the future, confin
studies to the minimum level necessary to meet th
(2) define and evaluate the projects for which Fe
will be required to permit necessary construction
in the next 10 to 15 years in sufficient detail t
basis for authorization; and (3) identify the gen
scope of the parts of the plan which should be un
non-Federal or other Federal programs, limiting s
the minimum necessary to insure proper balance.

f. Project planning will continue to b
directed by Congress. We recognize that there wi
individual project reports and some urgent projec
interim reports to comprehensive studies.

g. Studies will rigidly adhere to the
terminated at such a point as it becomes apparent
study would not produce justifiable improvements.

plan to issue from the Office of the Chief of Engineers ne
k instructions which require plans of survey and cost esti
comprehensive studies which conform to the specific objec
limitations of scope and refinement as set forth in that
is also contemplated that the departments will issue joint
tructions to implement the coordination of budget estimate
prehensive studies for Fiscal Year 1965.

Last Thursday and Friday, some of us from the Office of
ef of Engineers went to Louisville to review the Wabash co
sive study based on the revised concept. The Corps intend
iew in the field with the Divisions and Districts concerne
plans of survey and cost estimates for the 25 comprehensi
dies in the Fiscal Year 1964 budget by October, based on t
cept we have developed with the other three departments.

In summary, we contemplate:

a. Reduction in coverage of framework comprehensiv
ns.

b. Reduction in refinement of plans for individual
in comprehensive plans confining them to:

(1) An appraisal only of long-range needs and
utions.

(2) Survey scope detail only for projects to b
tiated in the next 10 to 15 years.

c. Review of cost estimates for the comprehensive
have budgeted for using this revised concept as a basis.

UNITED S

Committee or

March

The Honorable Kermit Gordon, Director
Bureau of the Budget
Washington 25, D. C.

My dear Mr. Gordon:

In your letter of February 6, 1963, you state specific attention to the coordination of the esti research and survey funds of the four principal De this field. Also, the Budget Message this year st emphasis is being given within the Federal Governm planning of river basin development and research c Reference is also made to the President's Message of February 23, 1961, in which it was asserted tha accepted the goal set by the Senate Select Committ that comprehensive plans be developed by 1970 for the Nation.

Within the Executive Branch of the Government Bureau of the Budget from the standpoint of the co the program is the logical organization to review established for coordination of the activities of engaged in the field of water resource development assure that the objectives would be accomplished i and effective manner. We are confident that pract experience in this field recognizes the desirabili planning. It is only in the implementation of tha differences of opinion may arise.

A partial examination of the increased cost o

f review with the responsible agencies the tentative estimat
r portions of these studies with a view to developing a more
istic approach to the formulation of river basin plans to th
ee of refinement necessary in the various portions of the st
rising the overall plan or framework, as well as the suitabi
urrently available information for the development of these

In the meantime, in order that the appropriate subcommittee
ore the various facets of this problem, it is requested that
ish the undersigned a listing by Departments of the various
cies engaged in these comprehensive studies. It is desired
furnish the following information for each entry: Agency,
opriation title, appropriation fiscal year 1963, budget fis
, including 1964 budget allowance to specific basins where
nt of 1964 budget required for comprehensive studies, total
nated cost of agency's share of comprehensive studies, amou
opriated to date, and remarks. Include under remarks the ex
n the estimate of the agency has been approved.

In view of the fact that hearings are currently under way
e, it would be appreciated if the tabular information reque
d be furnished at the earliest possible date.

Very sincerely yours,

/s/ Allen J. Ellender

Allen J. Ellender, Chairm
Subcommittee on Public Wo

EXECUTIVE OFFICE OF THE PRESIDENT

BUREAU OF THE BUDGET
Washington 25, D. C.

Apri

MEMORANDUM FOR HONORABLE CYRUS R. VANCE
Secretary of the Army

Subject: River basin planning studies

Attached is a copy of a letter to the Bureau of the
Senator Ellender raising general questions concerni
undertaking comprehensive river basin studies and r
cific budgetary information on such studies now und
for 1964. Members of the Bureau of the Budget staf
informally asked representatives of your Department
cific information requested regarding the studies c
Corps of Engineers so that it may be forwarded as s

The questions posed by Senator Ellender underscore
careful review by each agency of the planning conce
its basin planning effort and of the fiscal impact
concepts. Such a review would undoubtedly involve
of the role of future planning efforts in individua
for long-range water resources development, in addi
significant bearing on 1965 budget requests. Accor
appreciate your designating a representative who is
to properly assess such matters and maintain close
Bureau of the Budget during this review process. W
an early meeting of the representatives of the seve
agencies with members of my staff to consider furth
accomplish our mutual objectives. In case there ar
concerning this matter, they should be addressed to

EXECUTIVE OFFICE OF THE PRESIDEN

BUREAU OF THE BUDGET
Washington 25, D. C.

Apri

Honorable Allen J. Ellender
Chairman, Subcommittee on
Public Works
Committee on Appropriations
United States Senate
Washington 25, D. C.

Dear Senator Ellender:

In response to your letter of March 15, 1963, there is e
tabular information you requested on comprehensive river
This information was supplied to us by the four Departme

As part of the information requested, you asked for an i
the extent to which the estimates of the agencies have b
For each agency the total amount recommended for compreh
in 1964 was approved by the Bureau of the Budget. Withi
specific amounts for each basin included in the 1964 bud
mined by the agency concerned. As noted in your letter,
of the surveys was not approved by the Bureau of the Bud
commitment made to any specific level of funding for fut

We agree with the views expressed in your letter of the
making best use of currently available data and achievin
of refinement in order that the objectives of comprehens
be accomplished in the most economic and effective manne

In preparing the 1964 budget, our first aim was to achie
schedule directed toward attainment of the planning goal

We appreciate your constructive suggestions on these m
be of further assistance while the reviews outlined ab
undertaken, please let us know.

Sincerely,

/s/ Elmer Staats
Deputy Dir

Enclosures -4

cc: DO Records
Dir/Chron.
Deputy Dir.
Mr. Schwartz
Mr. Warner-Mr. Johanson
Mr. Kraus
Labor-Welfare Division
Mr. Barry

RCW:RDTeeters/JMJohanson;lg 4-23-63

DEPARTMENT OF THE ARMY
COMPREHENSIVE RIVER BASIN SURVEYS
(in thousands of dollars)

Agency: Corps of Engineers
Appropriation title: General Investigations

Basin	Appropriations Through FY 1962	FY 1963	Budget Request 1964
Big Black River, Miss.	0	(10) 1/	25
Big Muddy River, Ill.	199 2/	60 3/	115
Brazos River, Tex.	75 2/	140 4/	200
Colorado River, Tex.	376	203	215
Connecticut River, Conn., Mass., Vt., & N.H.	0	100	250
Fox River, Wisc.	46 2/	35 3/	75
Genessee River, N.Y. & Pa.	30 2/	100 3/	150
Grand River, Mich.	192 2/	100	200
Kanawha River, W.Va., Va., and N.C.	0	200	150
Missouri River Basin	0	0	250
Neches River, Tex.	(162) 2/	75 3/	110
Ohio River Basin Review	1,956	500	870
Pascagoula River, Miss.	(39) 2/	100	150
Pearl River, Miss.	0	25 3/	100
Puget Sound Area, Wash.	0	0	150
Red River below Denison Dam, La., Ark., Okla., & Tex.	110 2/	300	250
Sabine River, Tex.	146 2/	95 3/	115
St. Francis River, Ark. & Mo.	0	0	25
St. John River, Mo.	0	15 3/	85
St. Joseph River, Mich. & Ind.	0	5 3/	100
Susquehanna River, N.Y. & Pa., & Md.	374 2/	300	330
Upper Mississippi River Basin.	0	200	325
Wabash River, Ind. & Ill.	334 2/	200 3/	250
White River, Ark. & Mo.	37 2/	100	250
Willamette River, Oreg.	0	100	350
Total	2,332	2,953	5,090

DEPARTMENT OF HEALTH, EDUCATION, AND WELFA
COMPREHENSIVE RIVER BASIN SURVEYS
(in thousands of dollars)

Agency: Public Health Service
Appropriation title: Water supply and water pollution cont

Basin	Appropriations Through FY 1962	Appropriations FY 1963	Budget Request 1964	Balanc to Comple
Arkansas-Red River ...	1,526	361	0	0
Chesapeake Bay - Susquehanna	90	250	900	3,000
Columbia River	288	236	400	1,500
Great Lakes-Illinois River	2,000	3,180	2,785	5,400
Delaware River	55	150	310	900
Upper Ohio River	0	100	500	2,200
Lower Missouri River .	0	0	100	2,900
New England Rivers ...	0	0	150	4,400
Southeastern Rivers ..	0	0	200	3,600
Tri-State Metropolitan Area (N.Y., N.J., Conn.)	0	0	400	11,600
Colorado River	919	511	511	1,600
	4,878	4,788	6,256	37,100

1/ Rounded to nearest $100 thousand.

DEPARTMENT OF THE INTERIOR
COMPREHENSIVE RIVER BASIN SURVEYS
(in thousands of dollars)

gency: Bureau of Reclamation
ppropriation title: General Investigations

Basin	Cost Through FY 1962	FY 1963 2/	FY 1964 2/	Ba t Co
uget Sound Basin, Wash.	0	0	68	
illamette Basin, Ore.	3	0	156	
olorado River Basin	0	0	425	3
exas Basins Project (overall plan)	4,691	458	106	
issouri River Basin	0	0	522	4
laska	97	235	523	1
	4,791	693	1,800	10

/ Excludes costs for planning and general basin coordination activ
prior to FY 1964 which are not properly part of the comprehensiv

/ Amounts shown for FY 1963 and FY 1964 are on a cost basis and d
reflect any assignment of the underfinancing reflected in the F
budget now before the Congress.

DEPARTMENT OF AGRICULTURE

COMPREHENSIVE RIVER BASIN SURVEYS
(in thousands of dollars)

Agency: Soil Conservation Service
Appropriation title: Watershed protection

Basin	Appropriations Through FY 1962	Appropriations FY 1963	Budget Request 1964
Tombigbee and Pearl - Big Black	414	262	267
Upper Mississippi - Great Lakes	298	25	155
Susquehanna	0	87	149
Willamette	0	89	149
Ohio	0	129	248
Red	0	92	174
Genesee	0	72	112
Puget Sound	0	0	30
Colorado	0	0	52
Missouri	0	0	156
White	0	0	124
East Texas Basins	0	0	93
Grand and Fox	0	0	150
Connecticut	0	0	267
Total	712	756	2,136

Concept for Review of Types, Scope and Cost of Comprehensi

1. The desirability of comprehensive planning is gene
We realize that the Committees require information with res
implementation, and particularly with respect to the degre
of studies intended.

2. The estimated costs of the comprehensive studies
budget are tentative estimates which are the best that cou
for the FY 64 budget. The sums requested for FY 64 are fo
and by FY 65 hearings we intend to provide firmer estimate

3. The tentative total estimated cost of the Corps c
ning program is expected to be lower based upon reassessme
and scope of comprehensive basin plans needed as outlined
paragraph 7, below.

4. The amounts requested for FY 64 can be effectivel
the studies.

5. We still have much to do to firm up our concept i
ever, this can be accomplished with the funds requested, a
the comprehensive planning is intended to be curtailed in

b. Framework comprehensive plans will be limit

major river basins in which the contribution from and co

taries exert a major influence on the problems and solut

stem and for those geographic areas where the economic g

resource development potentials are closely interrelated

will not be duplicated but will be up-dated as required.

c. The scope of framework comprehensive plans

broad. They will be limited to an economic base study c

basin which projects the needs; to hydrologic studies ar

land resource availability which establish objectives fo

needs in terms of regulation, control and use of the wat

resources; and, as a maximum, to formulation of a genera

including major elements which would be required initial

d. For the rest of the Nation, we conceive tha

will be dispensed with and the comprehensive planning wi

river or tributary basin basis as the requirements of th

Congress directs. There may be a necessity to put toget

framework plan to pull together all resources, needs and

e. Comprehensive individual river or tributary

the minimum level necessary to meet these requirements; (2) e
evaluate the projects for which Federal authorization will be
permit necessary construction to be initiated in the next 10
in sufficient detail to comprise a basis for authorization; a
the general nature and scope of the parts of the plan which s
taken under non-Federal or other Federal programs to supplem
the projects for which authorization is sought, limiting stu
the minimum necessary to insure that proper balance has been
tween the two types of projects.

f. Project planning will continue to be carried ou
by Congress.

g. Studies will rigidly adhere to the principle of
at such a point as it becomes apparent that further study wo
justifiable improvements.

h. Funding of studies for cooperating agencies wil
be terminated at this point.

i. We propose to have a few people in each Divisio
function will be sub-basin comprehensive planning and prepar
of existing framework comprehensive plans.

EXECUTIVE OFFICE OF THE PRESIDENT
BUREAU OF THE BUDGET
Washington 25, D. C.

May

MEMORANDUM FOR BRIGADIER GENERAL HOWARD PENNEY
Deputy Director of Civil Works
for Comprehensive Planning
Corps of Engineers

Subject: Response to Senator Ellender's letter

The main questions that we believe are raised in Senat
letter of March 15, 1963, which require consideration
four agencies prior to a response are:

1. Degree of refinement

We take this to mean a clarification of the concept of
product is desirable and what effort needs to go into

a. What are the necessary elements of an eco
what indexes of future economic growth are required?
regional breakdown is necessary?

b. How far ahead should the translation of e
tions into water needs be attempted: 25 years, 50 year

c. How much and what type of hydrologic data
the purposes of such surveys?

d. For how far in the future should detailed
be attempted in the plans? What role does a general a
and possible solutions play?

b. Elimination of duplication on estimated costs, if
een agencies in given basins.

c. Differentiation between planning activities consi
n essential part of preparation of comprehensive plans gen
onsive to Kerr Committee recommendations, and those aspect
ain programs undertaken to achieve further but related obj
uch fields as pollution control, upstream watershed develo

e above information is furnished as agreed at our meeting
2.

E. FENTON SHEPARD

E. Fenton Shepard
Acting Chief, Resource
and Civil Works Divi

DRAFT 5/2

Honorable Allen J. Ellender
Chairman, Subcommittee on
Public Works
United States Senate
Washington 25, D. C.

Dear Senator Ellender:

This is in further response to your letter of Marc
flects the results of the review by the four Department
of refinement necessary in comprehensive river basin su
currently available data and the factors affecting the
in future years.

As stated in your letter, the desirability of comp
is recognized. In formulating programs for comprehensi
development, the four Departments have been guided by t
of the Senate Select Committee on National Water Resour
Standards and Procedures approved by the President on M
later published as Senate Document No. 97, 87th Congres
fully comprehensive basis is dictated also by recent Fe
policies and urgent needs calling for such new purposes
water supply, water quality control, recreational uses,
power, and fish and wildlife conservation.

In order to meet the basic objective of providing
combination of uses, of water and related land resource
seeable short and long-term needs, comprehensive plans

a. An appraisal of longer range water and rel

The Departments further consider that framework type p river basins or groups of basins where regional plans have completed would involve unwarranted duplication. They furt limiting framework comprehensive plans to those several maj in which the contribution from and control of the tributari influence on the problems and solutions on the main stem ar geographic areas where the economic growth and water resour potentials are closely interrelated. The scope of the comp work plans in these cases will be general and broad. They to an economic base study of the major river basin which pr for water resource development; to hydrologic studies and land resource availability which establish objectives for needs in terms of regulation, control and use of the water uses; and, as a maximum, to formulation of a general plan including elements which would be required initially.

For the rest of the Nation they conceive of comprehen an individual basin basis as the requirements of the regio meet requirements (a) and (b) above for an individual basi and efficient manner these plans would: (1) identify the g scope of water resource development needs which will be en periods, confining planning studies to the minimum detail to meet these requirements; (2) define and evaluate the pr Federal authorization will be required to permit necessary be initiated in the next 10 to 15 years in sufficient deta basis for authorization; and (3) identify the general natu the parts of the plan which should be undertaken under non Federal programs to supplement or utilize the projects for tion is sought, limiting study detail to the minimum neces that proper balance has been achieved between the two type

The Departments believe that through the comprehensive it will be possible to stimulate much more participation in process by the States and local interests. The States will nity, with adequate information, to participate in formulat and purposes of proposed water and related land development crystallized into specific projects. The Senate Select Com the importance of State participation by including a recomm Federal financial assistance to States to encourage State p formulating comprehensive plans and in decisions about wate ment.

The Departments have been asked for their views with r of economic projections and the degree of refinement that n in the various phases of comprehensive studies. They feel the broad Federal interests in water resources and the exte required to plan and develop them in a reasonably sound man with Senate Document No. 97, a look at future economic tren for the areas under study is necessary as a basis for antic dates in the future, the needs for water resources develop study describing the present economy of the basin and proje for such factors as population, personal income, heavy wate and agriculture will usually serve this purpose. Data used these projections are usually available for county areas. ning purposes projections by standard metropolitan areas an areas of rather uniform economic composition within the bou study area will generally suffice.

With regard to the period of economic projections to b planning studies, projections for 50 years will be adequate guidelines set forth in Senate Document No. 97 provide for based on periods equivalent to the useful life of major pro years. To firm up and lend credence to the assessment of b

Honorable Allen J.

As noted above, the comprehensive plans of developme defining in detail only those projects for which Federal be required to permit initiation of action programs, incl in the next 10 to 15 years. With any reasonable assumpti the economic growth of the nation one can be assured that the needs as projected in the study will be attained at a reasonably close to the target dates. Thus, projects sel needs as projected in the study for initiation in 10 to 1 to be adjusted to a reasonable extent timewise to corresp actually developing in the future. To plan projects in c periods is considered unnecessary and unwarranted.

The Departments intend full use of available data, s While most of the analysis can be based on reanalysis of a should be recognized that reasonable projection of longer consideration of needs for water uses not previously inve collection and evaluation of economic, water demand, agri data not previously required. In the absence of the Wate and river basin commissions proposed by the legislation t gress on July 13, 1961, it is believed that the coordinat presently established and continually being improved amo ments provide a satisfactory method for assuring suitabi data and procedures now available or to become available activities of the agencies. Through periodic formal and to review study progress and resolve problems each of the is informed as to the nature and extent of available data studies and data collecting programs currently under way, technical requirements of other agencies. I am confident understand the importance of, and are moving to effect, s tinued improvements in this field and to avoid any potent

Honorable Allen J. Ellender

programs in related fields undertaken by the Departments directives and legislation be considered. The source of Year 1964 for agency roles, as visualized by the individu a combination of estimated amounts to be transferred from Engineers to the cooperating agencies and funds budgeted agencies. The four Departments are now developing plans estimates for comprehensive studies beginning with Fiscal estimates will be prepared initially by field personnel i and will be jointly reviewed at the Washington level by t prior to review by the Bureau of the Budget.

Corps of Engineers Seminar on River Basin Planning

Role and Views of the Bureau of the Budget
by
Joel M. Johanson, Budget Examiner
Resources and Civil Works Division, Bureau of the Budget

From the early "308" reports to those recently completed for the Delaware, Texas and Southeast river basins much planning of generally comprehensive scope has been done by the Corps of Engineers and other Federal agencies. Within this period the purposes embraced by river basin planning have been significantly increased by legislation such as the Pollution Control, Water Supply, and Wildlife Coordination Acts. Also the planning process has become more complex as the need for full development, consideration of a wider range of alternative needs and solutions and for optimization of development plans has become increasingly apparent.

It seems clear that the studies and recommendations of the Senate Select Committee on National Water Resources have provided the primary stimulus for the currently increasing emphasis on comprehensive basin planning.

The first of the Select Committee's recommendations stated:

> "The Federal Government, in cooperation with the States, should prepare and keep up to date plans for comprehensive water development and management for all major river basins of the United States. Such plans should take into account prospective demands for all purposes served through water development giving full recognition to non-revenue yielding purposes such as streamflow regulation, outdoor recreation, and preservation and propogation of fish and wildlife, and keeping in mind the ultimate need for optimum development of all water resources."

The Committee also recommended that the Executive Branch be requested to submit plans to the Congress for undertaking and completing such studies in all major basins by 1970, and noted the need to (1) bring the plans up to date periodically, (2) specify how individual project recommended to the Congress for authorization fit the comprehensive plan, and (3) specify the range of alternative purposes that might be served by the resources needed for recommended projects.

The report of the Select Committee went on to point out that "the changing nature of water problems expands earlier concepts of the term (comprehensive planning), broadening its meaning far beyond that used in connection with the development and management of surface water resources."

The report further suggested (1) redefinition of the concept of comprehensive development to include consideration of all purposes served by water resources and all measures available for meeting prospective demands, including preserving and improving water quality and increasing the efficiency of water use; (2) recognition of full regulation of nearly all the Nation's streams as a long-run necessity, (3) planning in terms of the hydrology and economics of optimum use of the waters of the Nation's rivers and (4) scheduling of investments on the basis of growing demands.

Within three weeks of the transmission of the Select Committee report to the Congress early in 1961, the President in his Special Message on Natural Resources accepted the planning goal set by the Committee and recommended action to carry out certain of the Committee recommendations. Specifically, agency heads were requested to schedule a progressive, orderly program of starting new projects to meet accumulated demands and of implementing the report of the bi-partisan Senate Select Committee. The President also recommended that the Congress authorize establishment of planning commissions for all major river basins where adequate coordinated plans were not already in existence. Draft legislation to implement this recommendation was transmitted to the Congress by the President on July 13, 1961. In summary, the draft legislation proposed (1) establishment of regional or river basin commissions; (2) creation of a Water Resources Council to coordinate Federal activities in development of river basin plans and to maintain a continuing study of water supply requirements and management; and (3) financial assistance to the States to enable them to play a more effective role in planning for the development and conservation of water and related land resources.

The President's budget for 1963 featured an increased emphasis on comprehensive planning activities. For the Corps of Engineers, the start of 10 new comprehensive river basin studies was recommended, including those for the Susquehanna, the Connecticut, the Willamette and the Upper Mississippi river basins.

While the 87th Congress did not enact the proposed water resources planning legislation, support for the objectives of comprehensive planning was evidenced by actions and statements of the Public Works Appropriations Committees. The report of the House Appropriations Committee on the 1963 Public Works Appropriation Bill states:

> "River Basin Approach.--Implementation of the River Basin approach in the investigations programs is evident throughout the justifications presented this year. The Committee is convinced that this approach to water resources problems will evolve as times go on as the logical and least expensive means of assuring the wisest use of water resources. It does emphasize the need for additional and continuing cooperative

effort on the part of all agencies involved in any given area. However, the Committee does not expect it to become an excuse for requests for additional personnel and is convinced that realignment of responsibilities where necessary will serve to handle the workload."

The Senate Appropriations Committee in reporting on the same bill made the following statement:

"The report of the Select Committee on Water Resources indicated that the population of the United States in the contiguous portions was approximately 174 million in 1958 and will increase to 244 million by 1980 and 329 million by the year 2000; that in the next 40 years the consumptive use of water will have increased from approximately 109.5 billions of gallons daily to 156.3 billions; that commerce during this period on our waterways will have increased fourfold; and that our present rate of expenditure for flood control will have to about double, if we are to make any significant progress in the elimination of flood damages. It is imperative, therefore, that if we are to meet our responsibilities to future generations we must not only increase the rate of construction appropriations, but we must above all provide adequate funds for general investigations and comprehensive basin planning.

The bill recommended by the committee meets both of these desirable objectives."

Comprehensive river basin studies recommended in the 1963 budget were all approved by the Congress and one -- the Kanawaha study -- was added.

In his 1964 Budget Message, the President took note of the emphasis given to comprehensive planning and renewed his recommendation for legislation to provide for comprehensive and coordinated water resources planning by Federal and State agencies and to authorize limited Federal grants to strengthen State planning.

The 1964 budget provided for further strengthening of comprehensive basin planning programs and included the following general statement:

"Within the funds proposed for water resources investigations in 1964, major emphasis is being given to coordinated planning of river-basin development by the Corps of Engineers and the Departments of the Interior, Agriculture, and Health, Education, and Welfare. Planning already begun will be continued, and new comprehensive studies will be undertaken in several major river basins including the Missouri and Colorado Basins."

For the Corps of Engineers, funds were recommended for 13 new comprehensive studies including those for the Missouri River Basin and the Puget Sound area. Many of the comprehensive studies to be started by Corps in 1964 were "conversions" of studies previously under way for one or more purposes but considered to be of less than comprehensive scope. Such studies were broadened in order that it could be determined with reasonable assurance that projects recommended in early years would be consistent with longer range requirements for development of the basin for all purposes.

From the foregoing, it is clear that comprehensive planning in the programs of the Corps of Engineers and other Federal agencies was endorsed early by the present administration and continues to receive its support. Responsibility for realization of planning goals rests, of course, with the agencies whose programs will produce, or contribute to, the development of comprehensive plans for the various basins. The role of the Bureau of the Budget, in contrast, is primarily to assure that budgets for basin planning represent an adequate resolution of the conceptual and procedural problems associated with the planning process and provide for efficient, coordinated efforts of the agencies participating in the planning effort.

Pending enactment of legislation authorizing the establishment of river basin planning commissions and the implementation of such legislation, it seemed clear that a strengthening of agency river basin study programs was an essential step if valuable time was not to be lost. It was recognized that much of the Nation's expertise in river basin planning would necessarily be developed within the various Federal agencies and that the data and other information to be derived from agency efforts would contribute to the success of planning commissions when they were established.

Generally speaking the problems of primary concern to the Bureau of the Budget at the time the 1963 budget was being formulated were those of coordination of agency programs and of review and appraisal of agency efforts in the comprehensive planning field. It was quickly apparent that if the goal of completing studies for the major river basins by 1970 were to be met, vigorous action would be required to reproduce throughout the organization of the Corps of Engineers capabilities such as those demonstrated in the Delaware, the Potomac and the Columbia. While special efforts were made in formulating the 1963 budget to insure coordination of the investigations program of the Bureau of Reclamation and the Corps of Engineers it was recognized that further efforts of this nature but with broadened scope would be required in connection with the 1964 budget.

In the preview of the 1964 budget the Corps took a hard look at their program requirements through 1980 based upon the assumptions which underlay the report of the Senate Select Committee. This effort provided for the first time an over-all comparison of program

needs and the measures required to meet those needs over an extended period of time. These long range projections underscored again the urgency of action to define water needs in the Nation's river basins and to determine measures to meet those needs.

In formulating the 1964 budget it was considered essential to establish a means of coordination to assure that the planning programs of the several agencies gave full recognition to the related efforts of the others. To achieve this purpose, the Director of the Bureau of the Budget on June 4, 1962, requested the four Secretaries who would comprise the Water Resources Council under the Water Resources Planning Act to review efforts in developing comprehensive river basin plans; identify and assign relative priorities to basin planning; and jointly consider means by which adequate coordination of the planning programs of the four agencies might be assured.

On November 27, 1962, the four Secretaries transmitted the results of their inter-Departmental effort to accomplish these purposes. The Secretaries considered that the comprehensive basin planning effort proposed for 1964 was a desirable and feasible first step toward completing most urgently needed plans by 1970, initiating all plans by 1970 and completing all by the mid 1970's. They indicated, however, that there was a need to continue joint analysis of the problem of coordinating and funding the river basin planning program and to prepare a more definite schedule of nation-wide basin planning for use in preparing budgets for 1965 and subsequent years.

Other questions and problems were highlighted by the four-agency review. Among them were the sizeable dollar totals thought to be required in ensuing years to meet adequately the goals of the Select Committee and the need for a national economic framework analysis within which basin studies could be made. While rough approximations had been made of the cost of carrying out activities related to preparation of comprehensive basin plans, there were many unanswered questions in this field. Accordingly, the recommendations for comprehensive planning incorporated in the 1964 budget were regarded as a reasonable first step toward a coordinated river basin planning effort without commitment to concept or total cost of the program for all of the Nation's rivers.

It seems clear that advances have been made in the comprehensive planning program since 1962. Discussions with Corps staff at field and Washington levels indicate a greater understanding, acceptance and enthusiasm for the comprehensive planning concept than existed a year or so ago. Many steps have been taken to establish communication within the Corps, between the Office of the Chief and the various division and district offices, and between the Corps and other agencies, and State and local groups who participate in the planning process. Arrangements are underway to improve and make more efficient

the development of economic base data on a national basis through the Department of Commerce and through the Economic Research Service of the Department of Agriculture for agricultural aspects.

On the other hand, it is also clear that there is much unfinished business in the comprehensive planning process. To a considerable extent thus far, it has been assumed that the Delaware study represents a suitable prototype upon which future plans and estimates of cost can be modeled. In view of the substantial costs involved in this program, the great requirement for skilled manpower, and changes in legislation and policy since the Delaware study, it would appear that a critical review of concept and procedure is needed before the form, character, and scope of future studies is determined -- (1) To achieve a reasonable degree of consistency for the large number of studies that will be underway, it is necessary that at least minimum guidelines be established and other procedures developed to assure that the studies which are undertaken will produce a useful product for a reasonable minimum expenditure of dollar and manpower resources. (2) Means must be afforded to permit a study to proceed to the point at which its purpose has been served and then to be terminated without the added expense of untimely and unnecessary effort. (3) Ways of making full use of presently available data and adapting planning processes to minimum over-all data requirements also require study. (4) In view of the need for periodic review of basin plans, decisions are needed as to the appropriate period for study and the character and detail of consideration to be given various phases of the study.

Special problems are posed by studies presently underway for the purposes of flood control, navigation or other limited objectives which are proposed for conversion to fully comprehensive studies -- the questions here being: (1) what effect such action will have on the objectives of the going study, (2) what degree of comprehensive consideration is appropriate for the basin involved considering its size, stage of development, known potential and probable needs? It can probably be agreed that a basin under study should be reviewed in sufficient scope to assure that proposed development will not prove inconsistent with the wise use of the basin's resources. Yet whether this requires in each case the same extent of study as for basins facing broad problems of water resource adequacy is open to question.

As was noted by the four Secretaries in forwarding their recommendations for program coordination in 1964, there remains considerable need for further coordination efforts. The Bureau of the Budget considers such efforts essential to the success of the basin planning program. It must be assured that the related activities of the various agencies in each river basin are known to the others and plans so formulated that the greatest possible advantage can be taken of opportunities to share data and other costs. A careful review is

also required to determine those activities which are essential for development of an adequate river basin plan at each step in the planning process and what further activities may desirably, but optionally, be carried on at the same time as the comprehensive planning effort itself.

The Corps of Engineers and the Department of the Interior in consultation with other involved agencies are currently working to devise means of coordinating their activities in the proposed study of the Missouri Basin and the study getting underway in the Willamette. Such measures will undoubtedly be required in other basins where the responsibilities of these agencies converge. It is clear that if the Administration's objectives, and those of the Select Committee are to be met, a large number of basin studies will be underway simultaneously over a considerable period of years. Pending the establishment of river basin commissions to coordinate planning in each basin an orderly means will be required for scheduling studies, reviewing fund requirements within the executive and legislative branches, and assuring that funds are appropriated in a manner which will permit a balanced effort to be maintained on each study regardless of the agency which may carry out a specific part of the coordinated effort.

During the past few months, there has been evidence of concern on the part of appropriations committees and their staff with respect to various aspects of the comprehensive planning program including many of those enumerated above. At the request of Senator Ellender, the Bureau of the Budget has furnished data on costs of agency activities in 1964 and the total costs of studies underway in 1963 and 1964. As a further step, the agencies have recently been asked by the Bureau of the Budget to review their concepts for river basin planning and to determine actions which can be taken to assure that the program is carried out in the most effective and efficient manner possible.

The staff of the Bureau of the Budget is well aware that some concerns with respect to the basin planning program appear to conflict and that they pose problems which are exceedingly frustrating to those with responsibility for carrying out the program. It is recognized by the Senate Select Committee and by many authorities in the field that there is a need for broadened consideration of water problems in the context of basin planning. Specifically mentioned are: approaches which go beyond the volumetric approach to surface water problems and consider nonstructural alternatives; consideration of sub-surface as well as surface water characteristics; strengthened abilities to deal with the perplexing problems of alternative water use and to project with reasonable accuracy probable economic activity in future years; ability to interpret such projections in terms of their impact on water needs and to develop much more suitable means of developing plans for optimum water use.

At the same time there are important considerations of cost, efficiency, organization and allocation of scarce manpower and timely completion of studies which indicate a need for streamlined and efficient processes to accomplish the planning objective at the lowest possible cost. This is to say nothing of the added problems imposed by carrying out the planning mission in such a way that full consideration is given to the programs and interests of the various Federal, State and local agencies participating in plan formulation.

The comprehensive planning effort is clearly one of challenge for the Corps as well as the other resource agencies. There is need for innovation, broadening of concepts and adaptation of procedures to the changing demands in the water resource field. The progress of the Corps and others in meeting this challenge will be of great interest to the Bureau of the Budget in view of its importance to the water resource development goals of the administration.

River Basin Planning

Role and Views of the Secretary of the Army

by
Richard A. Hertzler, Chief, Office of Civil Functions
Office of the Secretary of the Army, Washington, D.C.

Authority and Responsibilities

Within the Executive Branch, generally speaking, authorities and responsibilities are distributed from the top to the bottom of command echelons in direct proportion. A corollary of this general proposition is that the commander of a lower echelon has no authority not possessed by the commander of a higher echelon. For some years this caused confusion within the Department of Defense whenever decisions of discussions centered on authority for the civil works program of the Corps of Engineers. We have all read many times the familiar phrasing of numerous laws pertaining to civil works: " . . . under the direction of the Secretary of the Army and the supervision of the Chief of Engineers." Nevertheless, the lawyers assured me that the Secretary of Defense could assume whatever authority he wished for this program both from a legal and a practical viewpoint. The situation was clarified on 9 May 1961 when Secretary McNamara delegated his authority for civil works to the Secretary of the Army, who therefore is the highest executive responsible for this program, excepting of course the Office of the President.

To effectively exercise his authority and discharge his responsibility, the Secretary of the Army has assigned duties and responsibilities for the civil works program to one of his immediate subordinates, in the past an Assistant Secretary, but currently his Special Assistant for Civil Functions. Of course, he has retained authority to make the major decisions, and he holds his principal assistant responsible for bringing these to his attention. Over the years this system has worked well, with the Secretary assuming a more or less active role depending upon current issues and problems. Obviously, the Secretary and his principal assistant must work together in close harmony, see eye to eye on all major issues, and have full confidence in each other. For this reason, in discussing the role of the Secretary of the Army in basin planning, I shall consider the responsible officials of the Army Secretariat as a team; and in expressing the role and views of the Secretary of the Army, I do not necessarily mean the present incumbent of that position, but rather the Army Secretariat in general.

Staff support at the Secretarial level is provided by the Office of Civil Functions, a small office consisting of myself and my associate, Mr. Donald F. Horton. I shall say more about this office later.

Role of the Secretary of the Army

For convenience I shall discuss the role of the Secretary of the Army in civil works generally, and river basin planning particularly, in the three broad categories of: (1) establishing policy, (2) implementing policy, and (3) performing other duties prescribed by law. The role of establishing objectives and goals is, or may be, common to all three.

Before continuing, I want to make it clear that while the Secretary makes major decisions in civil works, he bases his decisions largely upon staff studies and recommendations. Hence a key factor in the decision-making process is good, sound, solid, brief staff recommendations founded on adequate study and analysis which presents a clear picture of both sides of all issues. As one of my former superiors often repeated, there is no pancake so flat but that it has another side. The other side is essential in arriving at a decision, therefore it should be presented just as strongly and clearly as the first side. This minor diversion is mentioned to demonstrate the importance of staff work, and to assure you people of the Corps of Engineers who perform this work that your efforts are recognized and appreciated. But you must maintain staff work, as in the past, at the highest possible level of quality.

1. Establishing policy

The Secretary of the Army, along with the Secretaries of Agriculture, Interior and Health, Education and Welfare, is a member of the Water Resources Council. In this capacity he guides or establishes policy for water resources including basin planning. As a Council this group has under study such matters as cost-sharing, cost allocation, and benefits for recreation. Also, the Council is involved in coordinating future plans for basin planning.

The secretary of the Army submits to the Bureau of the Budget the annual budget estimates for civil works. We all know the importance of budgeting and the subsequent appropriation by the Congress in the process of basin planning.

Also, he is responsible for submitting to the White House, suggestions and comments during the preparation of Presidential messages, such as those on Natural Resources and Conservation. As

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these messages announce or confirm the President's views on policies on water resources, the Secretary plays an important part in shaping National water resources policy.

He signs all reports on bills sent to the Army for comment, and he submits legislative proposals originating within the Department of the Army. In this way he exerts the full power of his office toward establishing policies of the Congress and enacting legislation.

Another important role of the Secretary is the development of positions, policies, agreements, tactics and strategy through consultations with other department heads, the White House and the Bureau of the Budget. I am sure all of you realize that, in reaching decisions on many of our important problems and issues, political repercussions, long-range goals, and pressures from conflicting interest groups - all these must be weighed carefully and the impact on the program and on the several agencies of the decision must be appraised intelligently. In this arena the Secretary of the Army plays the principal role for the Corps of Engineers' water resources program. To illustrate the importance of this decision-making process I call your attention to the "Memorandum of Agreement" on a division of responsibilities between the Departments of Army and Interior for water resources development in Alaska, the Columbia River Basin and the Missouri River Basin.

Finally the Secretary of the Army makes decisions which establish policy in his day to day actions on correspondence, summary sheets, and other communications presented to him as the highest authority in the Department with responsibility for the water resources development program including basin planning.

2. Implementing policy

The second category of roles of the Secretary of the Army is the implementation of policies already established by law, executive order, Presidential messages, and other communications including for example telephone calls from the White House. Among the policies to be implemented by the Secretary, the major ones are:

a. General principles for fees and user charges will be established for all types of Federal natural resources. Insofar as basin planning is concerned, this applies chiefly to fees for use of recreation facilities and user charges for the Nation's waterways;

b. Research on all aspects of natural resources will be increased. I am sure all recognize gaps in our knowledge concerning basin planning that can be filled only by research;

c. Emphasis will be placed on the development of comprehensive plans for major river basins. Doubtless we will hear more about this topic during the rest of the week;

d. An orderly program of new construction starts for water resources development will be budgeted. Now an orderly program consists, among other things, of new starts which fit into and contribute toward the objective of comprehensive plans for the river basin as a whole. Where completed plans have not been developed we must make the best possible estimate based on judgment and available information concerning the relation of the new start to the anticipated basin plan;

e. Increased attention will be given to multiple-purpose and industrial water supplies;

f. A program of providing data on flood hazards will be accelerated to assist in regulating the use of flood plans. I believe that this program will assume a more and more important position in basin planning as time goes on;

g. An effort will be made to preserve reservoir sites for later development;

h. Sufficient land will be acquired at reservoir sites to develop the recreation potential;

i. A full scale attack will be made on the water pollution problem. In the future, particularly in the populated eastern portion of the United States, water storage for water-quality control will become the most important single purpose of comprehensive water resources development; and

j. All agencies of Government should work together in the interest of providing a greater recreational resource for the people of the United States.

In implementing these policies, the Secretary, obviously must comply with the large body of law enacted over the last century-and-a-half. He must exercise judgment concerning the use of his authority where these laws are permissive rather than mandatory, and he must make decisions as required by these laws. As some of these policies are very broad, his implementation must be coordinated with that of other agency heads, the Bureau of the Budget and the White House in the same manner as described previously for the development of policy, and for the same reasons.

Many Federal agencies, as well as the states, are involved in programs to develop the Nation's water and related land resources. These agencies operate under separate and often conflicting or overlapping legislative authority; they serve different interest groups; and they utilize different professions each with its own disciplines. Consequently to implement the Administration's objectives in basin planning requires team action at the highest levels as the general rule rather than the exception. As one example of policy implementation by the Secretary, I call your attention to the "Joint Reservoir Land Acquisition Policy."

3. Performing Duties Established by Law

The last of the three roles of the Secretary of the Army in water resources is that of performing duties established by law. A good example of this activity is the Secretary's function prescribed by law for the Oroville project in California where the amount of the Government's contribution to this project for flood control ". . . shall be determined by the Secretary of the Army in cooperation with the State of California, subject to a finding by the Secretary of the Army, approved by the President, of economic justification for allocation . . ." Again I want to emphasize the importance of your staff work, for the Secretary can't afford many mistakes in any of the roles he plays in the civil works program.

Another type of action required of the Secretary by law is in the field of regulatory functions. How does this relate to basin planning? I am sure that any of you who have been involved with the permit to dredge in Lake Michigan at the Burns Ditch site will agree, first of all, that these permits can be troublesome. But the direct connection involves the use of land which is one aspect of basin planning. Here the central issue is: Shall this area be used for a National Park, or for industrial development or for both?

Views of the Secretary of the Army on River Basin Planning

Having discussed the role, we now sight the other barrel of this double-barrelled assignment which is the views of the Army Secretariat on river basin planning. The policy statements by the President and others, previously mentioned, constitute ample reason for interest in, and concern with, comprehensive basin planning. Needless to say, therefore, the Army Secretariat has considered the associated problems and has views thereon. Perhaps the simplest way to express these views is to recite some of the statements taken from correspondence and public remarks. Here are a few of them:

-- From a position paper dated 16 January 1962, prepared under the direction of Assistant Secretary Schaub, "The Nation's Water Resources Program and the Role of the Corps of Engineers," which was transmitted to the Bureau of the Budget - "The Corps of Engineers should play the major role in the planning and development of the Nation's water resources."

The paper explained that the role of the Corps of Engineers should be:

"1. Acting through the Army Secretariat, to participate in the establishment of national goals and all important policies at the higher levels of government.

2. To provide information, positions, and recommendations to the Secretary of the Army for his guidance in all activities of the Water Resources Council.

3. To participate in the preparation and review of basin plans in concert with other Federal agencies, the States, and non-Federal interests, ...

9. Looking toward the future, the Corps should strengthen its program or research related to water problems, particularly in improving planning methods and procedures."

-- In an address at the White House Conference on Conservation on 24 May 1962, Secretary Stahr said:

"The Army's fundamental policy in the civil-works field is to participate cooperatively with all other elements of the National community in carrying out a unified and integrated national water-resource policy conceived in terms of the welfare of the Nation as a whole." And further, "In considering national needs, it is necessary to consider all purposes served by Water-resources projects and programs -- to consider them primarily not in relation to specific projects or programs, but rather as a whole body of needs which the combined programs must satisfy." He went on: "Efficient development requires a proper balance between these purposes and related land-utilization programs. River basins are generally the most applicable geographic units for program planning, but as time goes by we may have to give increasing consideration to interbasin transfers of water." In speaking of the policies, standards and procedures approved by President Kennedy, he said: "We, in the Department of the Army, intend to implement these standards in our comprehensive planning with all interested Federal, State, and local agencies." He also

stated: "Our task is not to broaden or expand our programs -- national growth will take care of that -- but rather to adjust and integrate our efforts in the interest of efficiency and economy in the broadest sense of the terms."

-- Assistant Secretary Schaub in a memorandum to the Chief of Engineers dated 4 September 1962 commented: "I have never been concerned about the Corps' capability for carrying out or constructing the most complicated and difficult engineering works. Its record is outstanding. However, I am deeply involved in the Corps' planning effort, and I am concerned about the Corps' capability to fulfill its important mission in this key function of the Nation's resource development." In the same memo he asked to discuss with the Chief of Engineers the Corps' plans for: "(a) broadening and strengthening the organization and management of its investigative program, including project surveys, comprehensive basin planning, and research, (b) scheduling and coordinating individual projects with broader comprehensive plans and over-all program objectives, (c) coordinating with other agencies, and (d) recruiting, training and encouraging planning personnel both in Washington and in the field."

-- In a letter to the Director, Bureau of the Budget on 16 November 1962 transmitting a paper on "Modern River Basin Planning and the Corps of Engineers," Secretary Schaub wrote: "We recognize fully the importance of organizational structure as a tool in the continuing improvement of our planning performance, and this office intends to work with the Chief of Engineers in his efforts to assure timely modifications of the field planning organization to meet the emerging needs of the job ahead. It is hoped that, in addition, the paper will convince you that this Department is fully aware of the nature, magnitude and importance of the basin planning task confronting the nation."

Incidently, this paper is worth reading again and again and I urge you to do so. I would like to remind you that the paper expresses a planning philosophy emphasizing that basin planning is a team job of many agencies requiring many disciplines, including economics, and that it is not a job for the engineer alone. It also lists a number of needed improvements which the Corps is endeavoring to accomplish in its basin planning. One of these, significantly, is aimed at recruiting and training personnel.

-- Mr. Powell Pierpoint, Special Assistant to the Secretary of the Army for Civil Functions who also is the Army General Counsel, now has responsibility for the Civil Works Program. Although he has served in this capacity for less than six months, those of you who have met him will, I am sure, agree that he has

in this short time formed sound views of the water resources program. One example of his views is expressed in a memorandum to the Chief of Engineers in which he says: "In FY 1964 the Administration has emphasized comprehensive planning for major river basins or regions of the Nation. In keeping with this concept, it has occurred to me that we could apply the same principles to our planning for the development of the Nation's waterways and harbors. Such planning also would advance the Administration's National Transportation program, particularly if the Department of Commerce would participate more actively than it has in the past in the planning effort."

In speaking about river basin planning, Mr. Pierpoint said: "In these programs, therefore, we seek to have all purposes, all interests, all skills, and all needs fitted together to form programs that will provide a lasting foundation for continuing and increasing prosperity. The specific end result we are seeking is a sound and comprehensive framework plan for the development of every river basin in the United States within the next decade. This is an ambitious program indeed, but we are convinced first, that it is possible, and second, that the investment required will pay great dividends for America's future."

Summary

From the foregoing account of the role and views of the Secretary of the Army in basin planning, it is evident that the Army Secretariat has a keen interest in this program. In fact I have heard three of those officials who have had responsibility for Civil works state that of all the problems and decisions confronting them, they found those relating to civil works the most fascinating and interesting.

The Administration's decision regarding the emphasis to be placed on comprehensive basin planning has increased also the cadence of Secretarial activity. This was expected of the Department of the Army by the responsible officials high in the Administration, and was the principal motivation in the reassignment of civil functions last January from the Assistant Secretary of the Army for Financial Management to the newly created Special Assistant to the Secretary of the Army for Civil Functions. The concept was to bring this activity closer to the Secretary and to devote more time and effort to it -- not by interfering with operations, but by more active participation by the Army Secretariat in major policy decisions where top-level representation is most effective.

The Army Secretariat recognizes fully the unique advantages of the civil-military organization of the Corps of Engineers, and it appreciates the contributions that this dedicated group has made by its hard work and integrity toward the development of the

Nation's water resources. By its performance in its key role, the Army Secretariat expects to protect the integrity of the Corps and to assure its leadership in comprehensive basin planning as well as in construction. It plans to do this by absorbing some of the pressures normally associated with this program and some of the shock of complex politico -- economic decisions which should be absorbed at Departmental or higher levels.

To aid the Secretary to participate in this program more effectively than in the past will require an addition to his staff -- not much, in fact only one or two professional people. One of these is a well known economist, Dr. Stephen Smith who comes to us from Colorado State University and who will join the Staff in July. His primary function will be in the comprehensive planning area, and he will spend a good bit of his time in the field getting thoroughly familiar with representative samples of all planning activity during the various stages of plan formulation. The purpose is not to engage in operations, but to generalize the problems and issues, focus attention on solutions to these, and work toward effective and efficient treatment of the economic aspects of basin planning.

In the Office of the Secretary, we have for some time needed a professional economist who can talk the language and aid the Secretariat in participating more meanfully in solving the interagency problems that are bound to increase in number and complexity. Steve Smith as a representative of the Office of the Secretary will be working closely with the Office, Chief of Engineers, and with many of you men in the field for the next year or so. After that he will return to Colorado State where I hope he will produce more good, capable young economists who will contribute to the planning effort in years to come.

So far as the Corps of Engineers is concerned, I am sure that you recognize the complexities of modern basin planning, and that you will seek out and correct weaknesses in the Corps' capability to maintain leadership in this most important phase of water resources development. This seminar is a manifestation of intent, but much hard work is ahead of you in the next decade.

I hope I have demonstrated that you have the support of the Secretary of the Army.

GENERAL OBJECTIVES OF RIVER BASIN PLANNING

By
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Summary

This paper is one of a series of four on the objectives of river basin planning. The others concern engineering, economic, and social objectives.

The paper relates the broad objectives of conservation, development, and use of river basin resources -- that is, satisfaction of the full array of demands on these resources stemming from human activities -- to the more specific needs or working objectives applicable to the conduct of specific river basin studies within the confines of Corps of Engineers' responsibility. This has been done in very general terms. Nevertheless, the working objectives and choice criteria which are suggested should permit river basin studies to be undertaken with the minimum effort necessary to determine the proper content, scope, and timing of Federal projects for which authorization must be sought.

Planning of any type has purposes and value only to the extent that it affords understanding and guidance in the field of activity with which it is concerned. River basin planning is no exception. Thus, in the broadest sense, the objectives of river basin planning are the same as the objectives of river basin development. Unfortunately, the river basin planner needs more than an instruction to "go ahead and plan." He must be armed with a set of working objectives which define his zone of activity and with criteria which permit him to choose between alternative courses of action. The following discussion is concerned primarily with concepts bearing on selection of working objectives and criteria.

The fundamental purpose of river basin planning is to devise sound action programs for meeting immediate and long-term needs dependent upon conservation, development, and use of water and related land resources. Good river basin planning provides a design for meeting these needs in an orderly, efficient, and timely manner. It provides for avoidance of the wastefulness of over-utilization of resources in point of time, location, and amount, and the detriment to progress attendant upon under-utilization with respect to the same indices. The scope and timing of planning activities in specific river basins must be set in terms of the nature and urgency of basin needs and these measures of planning effectiveness. Premature, excessive, delayed, or under planning are just as unsatisfactory as their counterparts in construction

and have more far-reaching adverse significance to those dependent on river basin development.

The requirements placed upon our water and related land resources are many and varied. They must serve an array of domestic, municipal, industrial, agricultural, and other human activities ranging from the siting of homes to satisfaction of aesthetic needs. They may occur in almost any combination and degree of urgency. The extent to which any of these needs may or should be served is dependent upon the capabilities of river basin resources, and the desires and capabilities of our people. Where conflicts exist -- and this is the rule rather than the exception in a complex economy -- they must be resolved by reasoned choice.

Before planning may proceed it is necessary to define the objectives to be served and select the criteria to be used in choosing between alternative arrangements for meeting them.

The bases for decision are rooted in complex and inter-related physical, economic, and social mores, principles, and procedures which control our activities as a nation. The weight given to individual criteria is established in the social-political process. It may vary considerably from time to time, ordinarily in cycles substantially shorter than the life-span of many water resource development projects. Accordingly, it behooves the planner to adopt objectives and criteria which are most likely to be significant over long periods of time and which, if adhered to, will provide a sound and uniform basis for appraising the effects of adjustments to meet shorter-run criteria.

These conditions are most likely to be satisfied if the river basin planner adopts as his broad objective the formulation of projects and programs for conservation, development, and use of water and related land resources for all purposes, both short and long-term, in combination and degree which will best contribute to maximization of the national welfare and, as his fundamental basis for choice between alternative courses of action, the criteria of economic efficiency. As an example, where there is need for transportation facilities the river basin planner should consider navigation works in terms of their possible contribution to the national economy, and possibly, to other measures of national welfare, and their efficiency relative to other modes of transportation. This concept, of course, has been stated in deceptively simple terms. The refinements in detail necessary to choose between and site, scale, and time the undertaking of specific projects are to be discussed in other papers in this seminar series.

Concern with the criteria of efficiency extends to our river basin planning activities. This involves consideration of both detail and timing. At the outset it must be recognized that any agency significantly concerned with more than the most limited or localized aspects of river basin planning must be concerned in some degree with all aspects of utilization of all basin resources. It does not follow that the responsibility of such an agency extends to planning all river basin activities in detail. Accordingly, as the first step in establishing a set of working objectives it is necessary

to recognize the programs under which river basin activities may take place. These are new and going programs in the Federal, non-Federal public, and private sectors of our economy. Equally important is recognition of the need for physical and economic balance between these programs.

Although subject to change, the range of Federal river basin developmental activities and interests at any point in time usually is reasonably well established in law and precedent as, for example, in flood control, water supply, and fish and wildlife enhancement. This range of activity comprises the field in which the bulk of detailed Federal river basin planning must be undertaken in the survey stage. While it is necessary to relate the work proposed for undertaking under Federal programs to that in non-Federal public and private programs to insure that they are in physical and economic balance, sound decisions in regard to Federal program content can be made without full detailed design of related non-Federal programs. For example, in determining the manner in which to best meet water quality requirements at a given river point it may be necessary to strike a balance between direct waste control measures and low flow regulation. The former ordinarily will be undertaken within the non-Federal sector of our economy, the latter frequently will involve new Federal project authorizations. In striking a balance it is necessary to have a clear understanding of the over-all scope and effectiveness of the direct waste control measures but not necessary to have detailed knowledge of all individual elements. Conversely, however, the Federal planner must define the low flow regulation measures in sufficient detail to provide a basis for authorization.

It is recognized that there may be areas of interchangeability between direct waste control and low flow regulation wherein physical and economic comparisons will be necessary before selection of the best way to get along with water quality control. These introduce complications but do not invalidate the fundamental soundness of avoiding detailed design in the non-Federal sector which is not pertinent to decision in the Federal sector. The same concept may be applied with respect to going and new programs in the Federal sector to further reduce the amount of detailed analysis which must be undertaken in the survey stage of Federal river basin planning.

Departure from the concept that Federal river basin planning must define in detail for all people all courses of action bearing on use of water and related land resources does not reduce the over-all amount of planning required in all sectors of our economy. It does, however, permit adoption of a realistic Federal river basin survey program in keeping with needs and without compromise of objectives.

Within the fortunate topical confines of a paper on the general objectives of river basin planning it has not been necessary to invade the morass of methodology and the strategy and techniques of detailed decision making. Admittedly, none of the general concepts so far set forth explain just how to choose between reservoirs and channel improvements or just how to determine if and when either should be undertaken. Nevertheless they do -- and rather

definitely so -- suggest a series of working objectives for the survey stage of Federal river basin planning, as set forth below.

Within the context of Corps of Engineers' responsibilities the working objectives for river basin studies should be such as to:

1. Provide a broad understanding of the full range of demands both immediate and long-range which are most likely to be placed upon the basin's water and related land resources. This will require illumination of the main thrusts of basin economic activity from which these demands will stem and expression of needs in terms of flood control, water supply, water quality control, navigation, recreation, and other services.

2. Provide a broad understanding of the ways in which these demands are most likely to occur over time and how they may be served.

3. Provide a more detailed understanding of the actions which should be taken now and in the near future to serve the established pattern of needs.

4. More specifically, provide, in the case of such basins as the Delaware, Wabash, and Willamette, (1) a sound basis for necessary current and near-future construction, and (2) an understanding of longer-range water resource development needs as a general guide to future planning and construction. In order to accomplish these objectives in an orderly and efficient manner plans for such basins should (a) identify the general nature and scope of water resource development needs which will be encountered in future periods, (b) define and evaluate the projects for which Federal authorization will be required to permit necessary construction to be initiated in the next 10 to 20 years in sufficient detail for authorization, and (c) identify the general nature and scope of the measures which should be undertaken under non-Federal or other Federal programs to supplement or utilize the projects for which authorization is sought.

In summary, a relation is established between the broad objectives of conservation, development, and use of river basin resources -- that is, satisfaction of the full array of demands on these resources stemming from human activities -- and the more specific needs or working objectives applicable to the conduct of specific river basin studies within the confines of Corps of Engineers' responsibility. The concept which has been outlined calls for no compromise in determination of the proper content, scope, and timing of Federal projects for which authorization must be sought, but provides a basis for limiting detailed investigation to the minimum level essential to this determination.

ENGINEERING OBJECTIVES IN RIVER BASIN PLANNING

by

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1. To oversimplify, the basic objective of any engineering task is to achieve the most appropriate and sound solution at the least possible cost. This objective is more complicated in the case of water resources planning because of the many functions which are involved and the uncertainties inherent in the forecasting of economic development. We are developing basin plans to meet the needs of the region many years in the future, yet the ability of man to forecast accurately many years in the future is very limited.

2. Consequently, it is important that in developing basin plans we make every effort to plan in such a way that we can ultimately develop and utilize the full potential of the basin water resources. This means that when we develop a reservoir site we should attempt to develop that site to its full potential i.e., we should be sure to the best of our ability that the site developed will not foreclose the future development of some other site which offers a better solution from a long range, broader purpose viewpoint.

3. Our engineering objectives for basin planning are thus the determination of the locations, types, sizes, design features, and costs of the projects which will form the ultimate basin plan. The degree to which we undertake to engineer basin plans and specific projects will depend on the type of basin plans under study.

4. For comprehensive detailed type plans which include projects proposed for authorization, the plans must include soundly conceived and engineered projects which have been developed in sufficient detail so that general locations, types, sizes, and costs are reasonably sound. Some modifications can be expected in the more detailed engineering to be conducted in the post authorization stage, but we do not want to be embarrassed then by too many major changes. While funds will not usually be available for extensive surveys and explorations in the preauthorization stage, it is necessary that subsurface explorations be made and that teams composed of engineers and geologists visit the areas and sites to examine local conditions, to recognize early the design and cost problems involved, and to assist in the development of solutions.

5. For "comprehensive framework type plans", the engineering must be less detailed but it must be adequate to determine the broad outlines of the basin problems and their solutions. In view of the limited nature of these studies maximum use must be made of techniques such as the utilization of results of previous studies, computers, and sound engineering judgement.

6. We as engineers know that there are few developments in the technical fields that are completely new. Commonly the new of today is built upon the knowledge, experience, and developments of yesterday. So it will be in engineering for comprehensive basin planning. In virtually every basin for which we are called on to develop a comprehensive plan, the Corps of Engineers has accumulated considerable knowledge of its land and water resources, present and past problems and its potentials. We should plan to utilize this knowledge, effectively and to initiate the work necessary to fill in the gaps in our data. Essentially the same situation exists in regard to the engineering tools we will need to use in comprehensive basin planning. The engineering objectives sought and the types of engineering problems encountered in basin planning are already familiar to us. However, we will need to adapt existing techniques and procedures as needed to do the required broad-scale engineering within time and cost limitations.

7. We all know, too, that it is important that in beginning of our basin planning we undertake to develop the hydrology of the basin on a comprehensive basis. Hydrology is the "basic" basin data for water resources planning. Without it we can do nothing. With it we can begin to map out potential solutions to the basins' water problems. I do not want to depreciate the importance of economic data or any other aspect of basin planning; all are vital. At the same time, however, we must not overlook the basic need for a complete and sound hydrologic analysis of the basin before we can undertake an analysis of potential water requirements and water availabilities and the development of basin plans.

8. Hydrological analyses are basic to indicate the flood problem and to the determination of possible flood damages. Hydrometeorological analyses are basic to establish maximum flood hazards and to facilitate safety in hydraulic design of structures, that may be proposed. Analyses of run-off in low, as well as high yield periods, are basic to indicate requirements for works to provide additional domestic or industrial water supplies, or to provide low-flow stream regulation for pollution abatement, navigation, irrigation, and hydroelectric power generation. Personnel familiar with such studies should be assigned responsibility for these analyses, which are basic to establishing effectiveness of projects to meet functional requirements as well as being basic to establishing monetary values of benefits.

9. In conducting comprehensive basin planning in the field offices, after water resource needs are established, the watersheds are investigated for the purpose of locating a project or combination of projects of

various types and sizes to provide for the needs. These include investigation of: dam sites above major flood damage centers and in vicinity of areas in need of domestic or industrial water supplies or having potential need for irrigation water. Multiple-purpose features, including adjacent and integral pumped storage possibilities, are considered at all available reservoir sites, along with their proximity to and utilization of potential power in contiguous power market areas. In some cases, reregulating reservoirs downstream from storage reservoirs enables several functions to be achieved where conflicting uses of impounded water may be indicated. Combinations of reservoirs and downstream local protection projects, or local protection projects alone, are considered for flood control or for major drainage needs. Combinations of large dams for main stem control and small dams to control tributary areas are also considered.

10. The development of a basin plan progresses from preliminary office studies and field reconnaissances by a small group of the most experienced engineer-planners who make preliminary estimates of benefits and costs of projects that show promise of meeting functional requirements. Steps in such preliminary studies are curtailed or altered if approximations indicate that economical solutions will not be achieved. When such preliminary project formulations indicate potential feasibility, assistance from others is mobilized to form engineering teams to make more detailed office studies and field investigations to prove, disprove, or modify the preliminary findings. The final recommendations are thus developed on a progressive and efficient basis; and expensive field operations which are necessary to assure completely adequate estimates of costs and benefits are kept to a minimum.

11. The investigations, estimates of benefits, preparation of preliminary designs, estimates of costs, and evaluation of the alternative plans to formulate projects or combination of projects to meet in an economical manner the present and future wide range of water resource needs, require team effort of a number of different kinds of professionals - engineers, geologists, planners, and economists. The objective of all engaged in comprehensive planning of a basis is to formulate a coordinated plan of improvement to achieve effective land and water resource development in a practicable and economical manner for the present and future needs of the people who are living or will live in the area. The project designs should be such that future needs that are not provided initially can be added at a reasonable cost at some future time when such needs are desirable and economical.

12. Engineers and geologists should collaborate in making preliminary design and estimates of cost in the early phases of project formulation and in establishing real estate requirements. Personnel familiar with real estate acquisition and personnel familiar with the engineering and real estate aspects of relocations also should make reconnaissances of proposed reservoir areas in these early stages of planning. The comparison of the numerous alternative plans should be based upon preliminary designs and estimates of cost prepared by engineering teams who are familiar with

hydrological, hydraulic, electrical and mechanical aspects as well as with the real estate acquisition and relocation requirements. The preliminary designs should be accomplished under the direction of engineer-designers who have experienced and have solved similar problems on construction of water control projects. Such coordinated effort will insure adequate cost estimates in the progressive stages of project formulation.

13. After preliminary selection of sites that appear feasible, and before final project formulation, one of the most significant needs for all comprehensive planning is to acquire adequate site information. Too often the economics of a project have been determined on the basis of hypothetical structures, the concept of which is based upon a superficial knowledge of the site. Site surveys with respect to both topography and subsurface geology should be sufficient to allow the engineer to select the best site or sites available, not only for a given project but as a part of an over-all basin scheme. We are faced with the problem of surveys and preliminary explorations sufficient to describe a large area yet selective enough to keep their costs within reason. Site selections should be made by a process of orderly elimination in which all branches of engineering should participate.

14. Sufficient design, based upon the functional requirements and upon the preliminary site explorations, should be made to determine the best and most economical structures to be built. A change in the design concept between the pre-authorization of survey stage and post-authorization or final design stage is often costly and represents wasted engineering effort. In this regard, a major problem is the dynamic change in certain resource development purposes that may occur during the interval between pre-authorization and final design. A case in point is the evaluation of conventional power facilities based on previous concepts of moderate load factor operation. Recent concepts of very low load factor operations and pumped storage potential should be evaluated.

15. Another objective which we cannot afford to ignore is that our comprehensive basin planning sould be kept abreast of new design and construction procedures. This will include the useful application of new materials. Planning and design procedures, based upon electronic computing, will often lead to better analysis with resultant economy. Continued and increased research will play an important role toward increasing the efficiency of our design. Probably one of the most urgent needs is the greater use of existing investigation methods and development of newer and more useful techniques for correlating the various compositional and structural properties of rocks with their mechanical behavior if we are to make progress in foundation engineering. The new field of rock mechanics offers promising research in this respect.

16. The basic engineering requirements with respect to solutions, standards, quality and degree of detail should include the use of standard criteria and methods presented in Engineering Manuals. Hydraulic dimensions, capacities, water-surface profiles, etc. for outlet works, spillways, stilling basins, flood channels, etc., should be based upon preliminary design utilizing the Corps published Hydraulic Design Criteria. Refinement in design and model tests are not usually required in preauthorization studies.

17. Comprehensive basin planning requires widespread cooperation and coordination activities with other agencies at field level during the course of planning studies. In those activities it may, at times, be necessary to commit the Corps of Engineers to the support of certain methods of attack or plans of development some time in advance of completion of comprehensive basin reports and their submission for review through usual channels. Our concern here is that the engineering aspects of such advance commitments are sound and supportable. It is not contemplated that any drastic changes in our procedures for submission and review of reports will be required. However, engineering staffs of Division offices and/or OCE should be called in for advance review of cases involving particularly important or complex engineering problems prior to field commitment in the plans involved. It will not be practical to promulgate rigid guidelines as to when such advance field reviews are necessary but each District Engineer should be alert to detect situations where such reviews are desirable and to request them at appropriate times.

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ECONOMIC OBJECTIVES OF RIVER BASIN PLANNING

by
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1. An important economic objective of every course of action, public or private, is to accomplish the intended purpose at the least cost, that is with the smallest possible imput of valuable resources. In one important respect, however, the economic objective is different in the public sector than in the private sector. In the private sector the individual person or firm charts the course of action and, assuming that he acts rationally, does so to maximize his or its own wellbeing. The response surface of the private, entrepreneur is bounded by his own calculus. The economic effects, good or bad, of his acts outside these limits concern him only to the extent that they take the form of legal constraints upon his freedom of action.

2. Quite different economic criteria are appropriate in the field of governmental action. The focus here is on the body politic as a whole. In the economic evaluation of actions by government all of the effects, beneficial or adverse, direct or indirect must be considered. This is, of course, the time-honored criterion of the greatest good for the greatest number or in the words of the 1936 Flood Control Act, that "the benefits to whomsoever they may accrue are in excess of the estimated costs." Thus, when the action being considered is one by the Federal Government, the scope of the economic evaluation is as broad as the National welfare. From the National viewpoint, the measure of the economic justification ofa Federal project is the extent to which the total cuantity of goods and services, tangible and intangible, available to all elements of the Nation is greater with the project than without it.

3. Economic evaluations in Corps studies are geared to the basic assumptions of an expanding economy and relatively full employment set out in both the Green Book and SD 97. These assumptions play an important role in defining the scale and scope of projects and programs. Their import in this connection is that the economic resources needed for a project would, in its absence, be utilized elsewhere in the economy and in such use would yield benefits at least equal in value to the cost of the resources. Thus, in economic terms, the optimum size of a project or system of projects is found at the point where the benefits and costs for the last added increment are in balance. This is the point at which the excess of benefits over costs for the project as a whole are maximized. To go beyond this point would mean that the benefits from the

additional increments of project size (scale or scope) would be less than the benefits foregone from alternative uses of the imputs required in these increments. The marginal point at which the benefits and cost for the last added increment are in balance sets the outside limit of economic justification. There is a considerable body of opinion among resource economists that, in view of the limited budget for resource developments, only those projects or segments of projects are economically justified for construction at any time as taken together will yield the largest possible return on the limited available funds. The practical difficulties of implementing this concept under present and forseeable conditions are so great, that the question of its theoretical validity is largely academic.

4. Accomplishment of the economic objective of minimizing costs necessitates a comparison of the available alternates for accomplishing the desired purposes. These alternatives may include projects or combinations of projects in both the public and private sectors of the economy. The ultimate problem is to select from the available alternatives, public and private, those means which in combination will meet the needs at least cost. This requires a comparison of alternatives in terms of their true economic costs rather than their financial or accounting costs.

5. These concepts are not new, of course. They are found in the Green Book and in SD 97. But it has been argued by some that they are static concepts in that they fail to recognize river basin development as an end in itself and that they are, therefore, inadequate for planning purposes. I consider this criticism to be completely lacking in merit. The Nation has set for itself the goal of a stepped-up rate of economic growth. To accomplish this goal will necessitate using all of our resources to their best advantage, that is to yield maximum benefits, and wasting none of them. Development that does not meet the least-cost test is wasteful of resources. Development for its own sake may be worse than no development at all if the end result is, for example, the bringing into production of new agricultural lands which only add to our already swollen agricultural surpluses.

6. Another matter of considerable concern in this connection has been the treatment of secondary benefits in project evaluation. If it is true that the National viewpoint requires consideration of the full range of project effects, how can the exclusion of secondary benefits be justified? The answer is quite simple. Of course, secondary benefits should be considered. But, and this is the crux of the matter, they must be considered both with and without the project. On the assumption that in the absence of the project the

only the difference in the secondary benefits with and without the project that constitutues a project benefit.

7. Unfortunately there is no generally acceptable basis for measuring secondary effects, especially in the "without project" condition. Conceptually it seems reasonable that secondary effects generally will bear a fairly consistent relation to the magnitude of the primary effects. On this basis we would have to conclude that the secondary benefits of a project for which the primary benefits were less than the costs would yield less secondary benefits than if the same resources were used elsewhere in the economy. In other words, a project which is not justified on the basis of primary benefits would have negative secondary benefits, thus further reducing its b/c ratio. Let me illustrate with an example, admittedly oversimplified. Let us assume a project whose sole primary benefit is an increase in the production of an agricultural crop - say wheat. Let us further assume that the project costs $1500 and results in increasing the production of wheat by 1000 bushels having a market value of $1.50 per bushel or $1500. After deducting the farmer's associated production costs of $600 the primary benefit to the project is $900. The b/c ratio based on the primary benefits is .6. Now let's look at the secondary benefits. The wheat is trucked to a country granary; from there it is shipped by rail to a mill where it is converted into flour; the flour passes through several wholesale and retail channels and finally reaches the baker who converts it into bread which he sells to the ultimate consumer. For each bushel of wheat originally worth $1.50 we now have 50 loaves of bread each selling for 20 cents, giving a total value of $10.00. A part of the difference of $8.52 in the value of the bread and in the value of the flour is considered a secondary benefit of the original project. Let us assume that the calculation determines this part to be equal to 10 percent of the increase in value or 85 cents. For the 1000 bushels this is equal to $850. When we add the $850 to the primary benefit of $900, the apparent total benefits are $1750 and the apparent b/c ratio is $1750 divided by $1500 or 1.17. What this analysis overlooks, of course, is that with the project the cost of producing the 1000 bushel of wheat is $2100 of which $1500 is project cost and $600 the farmer's costs; whereas, in the absence of the project the same wheat would have been produced at a cost not exceeding $1.50 per bushel or $1500 and would have generated equivalent secondary benefits.

8. There remains the problem of unemployed and underemployed resources. The Green Book and SD 97 recognize that even in an expanding economy there will be periods when unemployment nationally

or in local areas may exceed normal levels. Accordingly they provide for an evaluation of the beneficial effects as a result of a project in providing employment to labor and resources that would otherwise be unemployed. This is entirely sound in economic terms. But it is extremely difficult in planning long-range river basin programs to predict the probable levels of unemployment at specific times throughout the extended period of the analysis. As a practical matter, therefore, we are forced to prepare the overall plan on the assumption of relatively full employment with recognition to be given to the actual conditions existing in the economy at the time that consideration is given to the initiation of construction of specific projects. Even so, there are major unresolved problems in the evaluation of the so-called area redevelopment effects of river basin projects. For example, what account should be taken of alternative means of dealing with the problem such as moving workers to more favorably located or endowed areas? What assumption should be made concerning the persistence of unemployment in the area in the absence of the project? What portion of the project costs should be justified by benefits from purposes other than the alleviation of unemployment? Can there be any net benefits from relieving unemployment in excess of the increase in total National consumption? What recognition should be given to adverse effects in other areas? We are trying to find answers to these and other questions.

9. So far my comments have concerned the economic efficiency objective of river basin development, that is the size of the economic pie. What about the objective of income redistribution or, in the vernacular, who gets what size slice? I know there are those including some economists, who believe that income redistribution is a proper economic objective of river basin development. I feel that this is wrong. I believe that river basin development is a poor tool for the purpose of accomplishing income redistribution. Other means, largely political, are better suited for this purpose. The engineers, economists and other technicians engaged in river basin planning have no special competence nor responsibility in this area. Where for any reason beyond their control they must deal with income redistribution as a project or program objective they should, at the very least, indicate the cost to the Nation, in terms of income foregone, of deviating from the efficiency objective.

SOCIAL OBJECTIVES OF RIVER BASIN PLANNING*

By
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I. The ultimate objective of resource development is to meet the needs of people. The ultimate objective of a river basin program is, therefore, a "social" (that is, a "welfare") objective.

II. The principal way in which resource development enhances the aggregate contribution of a nation's productive plant to the satisfaction of material human needs is by increasing the magnitude of the stream of real wealth produced by that nation; that is, by the production of the things people require to improve their level of living.

III. Hence the primary social objective of river basin development should be to maximize the stream of real wealth that will flow from the use of its resources over a long period in the future.

IV. It follows that the social goal of resource development is, in large part, the attainment of the economic goal of resource development. But to the extent that a government assumes responsibility for satisfying more than the material needs of its citizens, its river basin development programs must be designed to produce aesthetic**, as well as economic, values. A nation's social objectives thus encompass its economic goals, but extend beyond them.

V. It must be understood, however, that it is the net return to the nation as a whole that must be maximized. Should a nation undertake to maximize the wealth produced in a single region it would quickly reach a point at which an increment of investment in that region would produce less than it would if invested in a less fully developed region, and this would make the return to the nation as a whole less than the potential maximum.

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* Main points made in panel discussion of the subject: "Objectives of River Basin Planning."

** The term aesthetic is used here to cover all non-economic values resulting from resource development, including inspirational and cultural values.

VI. To maximize the aggregate welfare of a nation's people it is necessary that the wealth produced by the nation as a whole be widely distributed Hence social objectives encompass "distribution," as well as production

VII. The principal means by which a nation achieves a better distribution of the stream of wealth issuing from its economic activities lie outsid the realm of resource development. They include such measures as the graduated income tax, "relief," "social security," and changes in the form of social organization.

VIII. Nevertheless, within limits resource development by public works can contribute to a better distribution of the wealth produced by a nation; in addition to increasing the magnitude of that wealth. This contribution can be made by the use of public works to stimulate economic activity in areas where the production of wealth per potential worker is substantially less than for other regions. These are regions variously referred to as "under-developed," "depressed," or areas of "unemployment."

IX. Public works programs can be used to stimulate economic activity in such regions by making them more attractive to industry. This can be accomplished by providing low-cost power (as was done by TVA in the Tennessee Basin), by making available low-cost water transportation, by providing an adequate water supply for industrial use, by protecting valleys in which the flood hazard is an inhibitory factor, by making the region more attractive for recreation, or by other means providing an environment under which the benefits of private enterprise promise to be higher than they would be elsewhere.

X. The use of public works for improving the distribution of wealth is, however, a problem which must be approached with considerable trepidation, and one which merits the most careful study of the nation' best economists; for it is quite possible that an effort to stimulate the economy of an under-developed area may be completely offset by reductions in the flow of wealth from other regions, and that these reductions may be accompanied by an increase in unemployment and relief costs in those regions. In general, unless the industry which is persuaded to establish itself in the region by means of the public works program, is a net addition to the nation's existing productive plant, adverse effects elsewhere will cancel out the beneficial effects in the region stimulated. Stated otherwise, unless a public works program for a particular region results in an increase in a nation's aggregate consumption, its beneficial effects in that region are being offset by deleterious economic effects elsewhere in the nation.

TYPES OF INVESTIGATIONS

By
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1. INTRODUCTION:

The recent emphasis on comprehensive river basin planning has resulted, concomitantly, in a set of terms widely used in connection with basin planning studies that are neither used with consistent meanings or understood regardless of the intended meaning. Indeed, the term "comprehensive" takes on different dimensions depending on the particular context in the mind of the basin planner using the term. For example, in connection with water resources planning the term comprehensive may refer to the areal extent of a study without reference to the nature and extent of the problems considered or it may refer to the complete opposite wherein the complexity of the problems are of paramount concern or it may refer to both areal extent and breadth of problems involved. Wayward definitions have sprung-up for a number of features and concepts pertaining to basin planning but basic to this problem of definitions is the true meaning of "comprehensive basin planning studies" and variations thereof. It is the intent of this paper to trace the meaning of this term through its recent evolution and to establish a meaning consistent with the Corps' concept of comprehensive planning based on the objectives of such planning.

2. TREATMENT IN ENGINEERING MANUAL:

In EM 1120-2-101 the following appears under a paragraph headed "Flood Problems, Related Problems, and Solutions Considered:"

> "Comprehensive basin planning. Favorable sites for reservoirs are not plentiful. It is therefore essential that all possible uses of sites be carefully considered to insure that the full economic potentialities as well as the social values of sites are fully and properly utilized initially or provisions made for full use ultimately. No particular use should be favored at the expense of other uses, and the plans ultimately adopted should be designed to provide the greatest over-all benefits to the region as a whole. Development of basin or regional plans and of practicable and economical solutions of specific problems that will fit into such basin plans will be undertaken in cooperation with other Federal and local agencies as required by law, interagency agreement, and administrative policy."

While details and application of comprehensive basin planning principles have recently been expanded, the basic views above, as set forth in the manual, remain inviolate.

3. BASIN PLANS:

In his message to the Congress early in 1961 on natural resources the President established as a goal of the administration, the preparation, by 1970, of comprehensive plans for the development and use of the water resources of the major river basins of the nation. As a step in appraising the magnitude of the task confronting the Corps of Engineers in its efforts to meet that goal, the Chief of Engineers, in July 1961, requested that the Corps' field offices formalize basin plans for each major basin and gave the following views as to the nature of a basin plan:

> "A basin plan is not necessarily a complete report, supported by full investigation, and having detailed coordination with other interested agencies. It is a live and growing plan based on the best information available at one point in time. Basically, it recites the land and water resources of the basin, states the needs to meet and stimulate projected development and presents a general plan to develop the resources to meet the needs."

The basin plans called for here would be reviewed periodically and updated and would serve, primarily, as basic guides to the effective conduct of the Corps' Civil Works program and to the formulation of formal comprehensive basin plans. Thus, while these basin plans would serve useful purposes, it was not intended that they would constitute or take the place of comprehensive basin plans as envisioned in the passage from the engineering manual as quoted above or as apparently called for to meet the goal of the Administration.

4. In a supplemental directive in August 1961 to the Corps' field offices, relative to the preparation of basin plans, the Director of Civil Works set forth the following definitions:

> a. River Basin. The usual unit for comprehensive planning is an entire river basin or an entire major tributary thereof. It is recognized that political units frequently are unrelated to basin boundaries and the waters of a basin may be used in areas outside the basin. Therefore, the use of a basin's water resources must be related to the entire area served, which includes both the basin and the adjacent areas concerned. For reporting purposes the river basins, per se, generally will not be larger than the major drainage areas shown on the "U. S. Water Resources Development" map defining activities of the Department of the Army, the Department of the Interior and T.V.A. However, the major drainage areas shown on that map may be broken down, as appropriate, into a number of river basin entities. Also, where advantageous, several minor coastal streams may be grouped into single areas for river basin planning purposes.
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> b. River Basin Planning. Comprehensive planning for the conservation and use of water and related land resources consists of the appraisal of the current and prospective economic

potential, capabilities, and shortcomings of the area concerned and the role of water and related land resources development relative thereto; the examination of the present and projected needs for the products of water resources development; the inventory of the water and related land resources of the basin; and the assessment of potential improvements best suited for timely development of those resources to satisfy present and projected needs. The needs under consideration should include all that are directly or indirectly related to the conservation and use of the basin's water and related land resources.

c. Basin Plan. As used herein, a "basin plan" is actually a "planning framework" and consists of an aggregation of potential water resources projects devised with a view to full control and use of the water and related land resources of the basin in the service of specific goals and to providing an over-all skeletal framework for the formulation of specific projects in accord with the trend of development defined therein. This planning framework, in many cases, may need to be formulated initially on the basis of broad general appraisals of present and projected needs and development potentials, without the benefit of constraints with regard to detailed economic assessments, project authorizations and similar factors associated with detailed project formulation at a later stage. This planning framework is loosely held and may vary distinctly with time and regional economic advances. Thus the planning framework is flexible and subject to continual revision, adjustment and up-dating to bring about an eventual evolution into a comprehensive, coordinated system of improvements designed to contribute in an optimum manner to the economic well-being of the basin.

These definitions deal with the areal extent of comprehensive planning but, more significantly, they refer to the "planning framework" as indicative of a plan formulated on broad general principles and probably lacking detailed assessments and recommendations for authorization. The basin plans, called for here would be of the nature of situation reports summarizing resources development conditions at a specific point in time.

5. That supplemental directive thus introduced the matter of scope with reference to planning investigations and plans of development. It treats with these matters as follows:

a. All basin plans will be comprehensive in scope. They will encompass for the entire area of each basin, all water control and conservation measures that can be foreseen as necessary now and in the distant future to meet the needs of the area served regardless of the agencies or interests that may have primary responsibility. For example, land treatment, fish and wildlife development, P. L. 566

programs, and similar programs at all levels of government and private enterprise should be construed as elements to satisfy definite segments of the needs and should be included in the plan. The planning framework will not be of survey scope and will not serve as a medium for project authorization.

b. The details of the planning framework will vary over a wide range, depending on such factors as basin needs, prior planning efforts and practical limitations. To meet the immediate objective outlined in paragraph 3 above, the details of the basin plan will be limited to the coordinated presentation of data readily available with particular emphasis on the definition of the basin needs. Back-up material in the district files to support the derivation of the planning framework is essential. The coordinated presentation may be in the form of (1) general statements regarding the physical and economic environments of the basin, general appraisals of present and future needs, brief resumés of existing developments, and a brief statement of the indicated nature of future developments; (2) summaries of complete comprehensive plans designed in detail in recent studies to meet all present and future needs for the products of water resources development; or (3) summaries of plans of development in various degrees of detail from older planning efforts or other sources and of limited scope and limited modern applicability. Obviously, for the long range objective, new comprehensive planning studies may be needed to develop acceptable basin plans. It is requested that the report on each basin plan formalized to satisfy immediate objectives, include an appraisal of the quality of that plan and a statement as to the need and urgency for new comprehensive planning studies.

It must be borne in mind that both the directive of July 1961 and the supplement directive of August 1961 deal with "basin plans." However, the latter directive specifies the comprehensive scope to be used in the formulation of the basin plans or planning frameworks.

6. SENATE DOCUMENT NO. 97.

The objectives of comprehensive planning were stated as follows in the "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources" published in May 1962 in Senate Document No. 97:

"The basic objective in the formulation of plans is to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable short and long-term needs. * * *

National economic development, and the development of each region within the country, is essential to the maintenance of national strength and achievement of satisfactory levels of living. Water and related land resources development and management are essential to economic development and growth.* * *

Proper stewardship in the long-term interest of the Nation's natural bounty requires in particular instances that there be protection and rehabilitation of resources to insure availability for their best use when needed.* * *

Well-being of all of the prople shall be the overriding determinant in considering the best use of water and related land resources. * * *"

7. That document also established the scope of multiple-purpose planning as follows:

"Planning for the use and development of water and related land resources shall be on a fully comprehensive basis so as to consider - (1) The needs and possibilities for all significant resource uses and purposes of development, including, but not limited to domestic, municipal, agricultural, and industrial uses of water; water quality control; navigation in relation to the Nation's transportation system; hydroelectric power; flood protection control or prevention; land and beach stabilization; drainage, including salinity control; watershed protection and management; forest and mineral production; grazing and cropland improvement; outdoor recreation, as well as sport and commercial fish and wildlife protection and enhancement; preservation of unique areas of natural beauty, historical and scientific interest; and (2) All relevant means (including non-structural as well as structural measures) singly, in combination, or in alternative combinations reflecting different basic choice patterns for providing such uses and purposes."

8. THE BASIN PLANNING PROGRAM:

As of June 1962 comprehensive basin planning had evolved to the point where (1) the areal extent was identified as an entire river basin or major tributary thereof and could extend beyond basin boundaries to include the area served by the water resources under consideration; (2) it was recognized that the details of the basin plan could vary from planning frameworks formulated on broad general principles to formal comprehensive basin plans defined in sufficient detail to warrant recommendations for authorization for construction; and (3) the scope of multiple-purpose planning as prescribed in Senate Document No. 97 included a multitude of uses and purposes of development. With this background and mindful of proddings by the Bureau of the Budget

through the Secretary of the Army, the Director of Civil Works, on 2 July 1962, requested the Corps' field offices to submit appraisals of the planning effort required to meet the Administration's 1970 goal for developing comprehensive plans for all of the Nation's major river basins. This request specified that:

> "Each comprehensive plan of a major basin or area will comprise as a minimum: (1) a basin- or area-wide economic base study and definition of needs for water and related land resource development, plus a framework plan showing the scope and nature of probable optimum arrangements for meeting those needs; (2) an outline of the more detailed studies (comprehensive sub-basin plans) needed to select from general solutions and objectives outlined in the framework plan and develop specific project recommendations; and (3) recommendations for authorization of specific projects that clearly emerge as urgent and obvious elements of the major basin or area plan which will be available upon completion of the more detailed studies; however, it is not intended that the framework planning effort be designed to formulate specific project proposals."

The information submitted in accordance with that request was used by OCE to prepare a preliminary summary study scheduled under the date of October 1962. That schedule indicated total study costs of about 175 million and an indicate completion date in the late 1970's for an assumed practical level of planning effort.

9. INTERDEPARTMENTAL DEFINITIONS:

The Coordination of Planning Programs dated November 8, 1962 as submitted in November 1962 to the Director, Bureau of the Budget by the four Secretaries (Interior, HEW, Agriculture, Army) defined four types of studies. These were:

> a. Comprehensive Framework Plans (Type I): Studies of an area that provide long-run economic projections of economic development, translation of such projections into demands for water and related land resources uses, hydrologic projections of water availability both as to quantity and quality, and projections of related land resources availability, so as to outline the characteristics of projected water and related land resources problems and the general approaches that appear appropriate for their solution.
>
> b. Comprehensive Detailed Plans (Type II): Type I plans plus plans in detail sufficient for authorization of one or more projects that are proposed for solution of an area's water and related land problems.

c. Project Plans (Type III): Plans of narrower geographic and analytic compass and usually relate to one project.

d. Other Surveys (Type IV): State surveys of water resources in which Federal agencies are cooperating.

10. The first three of these definitions preserved the concept that the types of studies would vary depending on the degree of detailed planning and/or the areal extent of the study area. The fourth of these is simply a convenience definition without reference to the nature and extent of the study. The first three of these definitions were carried over into the OCE paper "Planning for Water Resources Development and Management - THE OBJECTIVE" which was used as an inclosure to a letter from the Assistant Secretary of the Army (FM) to the Director, Bureau of the Budget in November 1962. That paper identified three general types of studies of primary importance as follows:

A. The comprehensive basin "framework" study;

B. The detailed comprehensive basin, sub-basin study; and

C. The specific project or specific purpose study.

These studies may be accomplished separately, in sequence, or may be accomplished simultaneously.

The "framework" study should provide broad appraisals of needs, both short-term and long-term, and develop the general nature and scope of a basin plan by means of which these needs can be met, reserving development of details for sub-basin or sub-area studies and specific project studies. Thus, the "framework" study must be dynamic, subject to continual revision and updating to meet changing needs.

Where the "framework" study indicates a need or series of needs, a detailed sub-basin study then may be undertaken to devise a specific action plan defining in detail the projects which should be authorized for accomplishment. Specific project studies are generally similar to sub-basin studies except that they apply in the case of those urgent local problems which cannot await completion of comprehensive planning studies and which may be solved effectively in a manner compatible with the indicated plan of development for the basin.

11. Thus, there evolved the concept that framework studies, comprehensive basin studies and specific project studies varied, primarily, with the degree that each progresses toward project authorization or an action program. It must be noted, however, that comprehensive basin and specific project studies accomplished separately would need to contain, among other things, appraisals of needs and assessments of development potentials in much the same manner as a "framework" study.

12. **BASIN PLANNING DEFINITIONS:**

In a paper titled "Basin Planning Definitions" prepared in OCE and distributed to Corps' field offices in March 1963 the features and work items of comprehensive studies were listed as follows and the types of studies were related thereto as indicated in paragraphs 13, 14 and 15 below:

a. Coordination of the activities of Federal, State and local agencies cooperating in the report and the administration of the over-all planning and report effort.

b. A narrative history of the investigation and discussions of the contributions of other agencies and the general arrangements for the conduct of the study.

c. A description of the geographic and socio-economic features of the basin and water dependent area.

d. Projections of the economic indices for the area.

e. The assessment of present and projected basin needs for flood control; supplies of municipal, industrial, and agricultural waters; waterborne transportation; recreation; fish and wildlife; hydropower; and other goods and services of water resource development.

f. Hydrology studies of high and low stream flows including flow frequencies, storm and drought studies, water availabilities, unit hydrographs, flood flow and low flow routing techniques, and reservoir operation studies.

g. Inventory of physical potentials for development of the basin's water resources. In special cases it may be necessary to inventory out-of-basin potentials for meeting in-basin needs.

h. General geographic orientation of the basin needs with respect to the development potentials.

i. Detailed project formulation studies to define, by successively refined analytic steps, the optimum and alternative plans of development to meet present and anticipated needs.

j. Field surveys, subsurface investigations, borrow area investigations, real estate appraisals and other field investigation to assemble information as bases for project design and cost estimates of varying degrees of refinement from those needed in the successive analytic steps referred to in item i. above to those of survey scope referred to in item k. below.

k. Detailed project design and cost estimates of survey scope, and preparation of project plates for projects in the optimum and selected alternative plans of development.

l. Economic analysis (including B/C ratios), cost allocations and cost apportionments for the elements of the optimum and selected alternative plans of development.

m. Drafting of report and accompanying appendices.

13. In "framework" studies the scope of the investigation is curtailed short of project formulation and items i. to l., inclusive, in the above list of study features are not undertaken. Such a study would simply present an assessment of present and projected water needs and a general outline of the development potentials to meet those needs. This type of curtailed study could constitute proper planning levels for basins wherein the assessments of needs show no requirements for project development in the reasonably near future, say the next 20-25 years. In the framework studies for major basins such as the Ohio, Upper Mississippi or Missouri basins the initial investigations may be limited, for practical reasons, to main-stem needs and, thus, the curtailment may be primarily geographic in nature. In this type of study features i. to l., inclusive, may not be undertaken except in the case of sub-basins in which the main-stem needs constitute the principal requirements for development of the sub-basin's water resources. The significant point here is that in no case will detailed solution for main-stem problems be proposed without examination of possibilities for profitable concurrent solution of tributary problems.

14. The comprehensive basin studies are to be undertaken for those basins in which the assessments of needs indicate that an orderly development of the basin's water resources should get under way at an early date. In such case the study must include detailed project formulation and recommendations for authorization for construction of the required improvements. The comprehensive basin studies include all of the study features listed above. Where a framework study of the parent basin already has been undertaken, the introductory steps of the comprehensive basin study will be adjusted and curtailed accordingly.

15. The specific project studies are, in reality, a version of the comprehensive basin studies. The objective of specific project studies is to provide authorizing vehicles for improvements and control works needed to resolve local problems of such nature and magnitude at the present time as to warrant early corrective measures. The problems considered and the plans proposed in such reports ordinarily would be of such narrow geographic compass as to provide scant basis for extensive basin-wide planning studies or of such narrow compass, with regard to the problems involved, as to make unnecessary a comprehensive multi-purpose investigation. Because of the geographic and/or problem constraints encountered in the specific project studies, the plans proposed therein are limited to single projects, a few inter-related projects or projects unrelated to basin-wide development. Studies in this category include all of the study features and work items listed above although the treatment under most items can be kept to the minimum required by good report practices for investigations of this scope.

16. BASIN PLANNING CONCEPTS:

A great amount of effort recently has gone into firming-up the Corps' concepts of basin planning. While much remains to be done to fully firm-up the details of these concepts, they may be expressed in general terms as follows:

a. Framework comprehensive plans will be limited to those several major river basins in which the contribution from and control of the tributaries exert a major influence on the problems and solutions on the main stem. Existing plans will not be duplicated but will be updated as required.

b. The scope of framework comprehensive plans will be general and broad. They will be limited to an economic base study of the major river basin which projects the needs; to hydrologic studies and projected related land resource availability which establish objectives for meeting those needs in terms of regulation, control and use of the water and related land resources; and, as a maximum, to formulation of a general plan of development including major elements which would be required initially.

c. For the rest of the Nation, framework plans will be dispensed with and the comprehensive planning will be on an individual river- or tributary-basin basis as the requirements of the region require and Congress directs. There may be a necessity to put together later a form of framework plan to pull together all resources, needs and potentials.

d. Comprehensive basin plans should cover basins generally comparable in size to such basins as the Delaware, Wabash, Pee Dee, and Willamette. The objectives of such plans are to provide (1) a sound basis for necessary current and near-future construction and, (2) an understanding of longer-range water resource development needs as a general guide to future planning and construction. In order to accomplish these objectives in an orderly and efficient manner sub-basin plans must (1) identify the general nature and scope of water resource development needs which will be encountered in future periods, confining planning studies to the minimum level necessary to meet these requirements; (2) define and evaluate the projects for which Federal authorization will be required to permit necessary construction to be initiated in the next 10 to 20 years in sufficient detail to comprise a basis for authorization; and (3) identify the general nature and scope of the parts of the plan which should be undertaken under non-Federal or other Federal programs to supplement or utilize the projects for which authorization is sought, limiting study detail to the minimum necessary to insure that proper balance has been achieved between the two types of projects.

e. Project planning will continue to be carried out as directed by Congress.

f. Studies will rigidly adhere to the principle of being terminated at such a point as it becomes apparent that further study would not produce justifiable improvements.

g. Funding of studies for cooperating agencies will, similarly, be terminated at this point.

17. COMPREHENSIVE BASIN PLANNING STUDIES:

There has evolved, through the several directives and guidelines cited above, detailed definitions and general concepts directly applicable to the Corps' basin planning studies. While the areal extent and scope of multiple-purpose planning are well defined, it is recognized that, in tailoring studies to the problems encountered in individual basins or problem areas, framework, comprehensive or specific project studies may be dictated by the degree of planning that is warranted in the specific case under study. Also, the Corps' concepts of basin planning requires further tailoring of study details and the use of the various types of studies to assure an efficient, economical and well managed comprehensive basin study program. While the various types of studies can be defined in general terms with respect to certain study dimensions there will be few instances wherein they will fit fully into specific Types I, II, III or IV. Thus there seems to be little or no merit in perpetuating the terms Type I, Type II, etc., insofar as the Corps' planning program is concerned. Perhaps a more meaningful breakdown of planning efforts with respect to the extent of detail and complexity would be (a) the situation plan, (b) the preliminary basin framework, or (c) the individual or sub-basin comprehensive plan and from the standpoint of narrow geographic and analytic compass the specific project plan might be a most appropriate category.

OBJECTIVES OF INDIVIDUAL STUDIES

By
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Summary

This paper is one of a series on the general theme of "Objectives of river basin planning, types of investigations, and study cost estimates."

It recognizes that the fundamental objectives of studies bearing on conservation, development, and use of water and related land resources are the same regardless of study type or scope. An additional "working objective" is defined for individual studies calling for their undertaking in the climate most favorable to sound planning.

Regardless of the type or scope the fundamental objective of any study bearing on the water and related land resources of a river basin is to make a sound contribution toward orderly, efficient, and timely conservation, development and use of these resources. Accordingly, any study which defines an action program should be carried to the point of assurance that its content, scope, and timing are proper in terms of the chosen criteria for decision.

For purposes of this discussion the term "individual studies" has been taken to mean studies of limited areal or functional scope, and the term "objectives" has been taken to mean the guide lines necessary to relate such studies to possibly broader river basin problems and activities.

The nominal scope of individual studies is set by such factors as:

a. The authorizing resolution or enactment.

b. The desires of local interests expressed in public hearings and via other channels.

c. An urgency of problem warranting attention via interim report.

d. Obvious physical and economic independence from or domination of broader programs warranting attention via interim report.

e. The specifications of small project authorities.

When the conditions of physical and economic independence or domination prevail (ie: where developments arising from an individual study clearly would bear no significant physical or economic relationship to others, or clearly would comprise a part of any plan likely to be developed by more extended study) individual studies pose no special problems and may be undertaken under the quality controls applicable to basin studies, restricting detail to that necessary for sound decision as to the content, scope, and timing on the individual study plan.

When physical and economic independence or domination are not obvious, and resultant complications are likely to be significant, the following general courses of action listed in order of preference are available:

1. Inclusion of the study as part of a basin-wide investigation.

2. Extension of the study to provide at least minimum physical and economic ties to related water resource development needs and activities.

3. Completion of the study without establishing physical and economic ties to related water resource development needs and activities.

Where the first alternative is feasible with respect to authorizations, public relations, and lack of urgency it should be adopted without hesitation. An understanding of the advisability of such an action by all concerned might be facilitated through the coordination mechanism for the parent study.

Where combination of reports is not feasible or problems of physical and economic dependence are not too serious to be handled by separate report procedure the possibilities of minimum extension of the scope of the individual study should be explored. Close coordination with study sponsors should be helpful in such cases.

Where the terms of authorization or other factors are such that there is no alternative to submission of an individual report without providing minimum physical and economic ties to related water resource development needs and activities the planner has a responsibility for making this clear in his report and taking it into account in his recommendations. Such adverse factors as early physical or economic obsolesence, physical or economic inadequacy, wasteful use of resources, and early need for modifications or adjustments at excessive cost should be brought out.

In summary, the tests of good planning apply equally to all reports. In the case of individual studies as defined herein there is an additional working objective requiring that the study be undertaken within the most favorable possible climate consistent with authorizations, public relations, and lack of urgency. Where this does not permit selection of a study climate favorable to sound decision the short-comings and consequences of the adopted report procedure should be made a matter of record in the individual report.

PARTICIPATION IN STUDIES

by
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INTRODUCTION

1. As some of you know, it happens that my vantage point for the last 25 years has been in the planning field for civil works at the District and Division level in the southwestern region of the United States. A few early years of my service in the Corps was in connection with the Muskingum Conservancy projects in Ohio back in the 1930's. Five years was as a staff member of the Corps-AWR office when we had the chairmanship of the Arkansas-White-Red Basins Interagency Committee. I have a working knowledge of the operations, procedures, and report of the U. S. Study Commission of Texas although my participation in that effort was to a minor degree. However, our Division and District offices had lead participation and our Division Engineers were members of the Commission. You may have to keep these things in mind in considering the views and suggestions expressed in this paper. There are perhaps other ways more applicable to certain situations. These different views are intended to be developed in group discussions scheduled for later in the day.

AT THE REGIONAL LEVEL

2. In keeping with the objective of comprehensive river basin planning, the Chief of Engineers has pointed out the importance of the establishment of formal coordinating arrangements with other Federal agencies and State and other local interests beginning in the early stages of river basin studies to provide a basis for full and continuing exchanges of views during the studies; advice and

assistance to all participating agencies in regard to objectives, work assignments, schedules and funding; assistance in the resolution of study problems as they arise; and periodic review by all concerned of the progress being made. Assistant Secretary of the Army, W. F. Schaub, in his letter dated 15 June 1962 to the Secretaries of Interior; Agriculture; and Health, Education, and Welfare, proposed that the four agencies begin immediately to coordinate further planning efforts on those river basins for which authority to proceed has already been provided by the Congress and on which studies by all or most agencies are already underway or contemplated in the immediate future. Mention was made that Congress had directed comprehensive studies by the Corps of Engineers be made of certain basins. Assistant Secretary Schaub stated, pending possible establishment of river basin commissions by legislation, that he proposed coordinating arrangements be established for these basins similar to those used effectively in the Delaware Basin study. He stated that with concurrence of the Secretaries he would propose establishment of coordinating committees, to include representatives of State as well as Federal agencies, for all comprehensive studies which the Congress has directed be undertaken by the Corps of Engineers under the Secretary of the Army.

3. In letter to the Director, Bureau of Budget dated 27 November 1962, the Secretaries of Agriculture; Army; Health, Education, and Welfare; and Interior stated:

> "Through the Interdepartmental Staff Committee, which we established last year to assist in the joint tasks assigned to us by the President relating to other water resource matters, we have completed coordination of water resource planning programs for reflection in Fiscal Year 1964 budget estimates, * * * *."

> "Consideration has been initiated concerning means by which adequate coordination of planning may be assured. For the Ohio Basin where planning is underway we have agreed to form a coordinating Committee of Federal and State representatives similar to that utilized in the recent Delaware study. Conclusions have not yet been reached as to the appropriate procedures for other river basins. We will inform you of these conclusions as soon as they have been reached."

A copy of a letter (27 November 1962) addressed to the Secretaries of Agriculture; Commerce; Interior; and Health, Education, and Welfare; and the Federal Power Commission initiating such action in connection with comprehensive investigation of the Ohio River Basin has been

furnished to the field by OCE, as has a list of designated representatives for certain other river basin study coordinating committees.

4. In most cases, it can be expected that the District or Division Engineers would be Chairman of formal regional committees organized for the purpose of accomplishing an investigation assigned to the Corps. The responsible District or Division Engineers would expect participation by representatives of Federal Departments of Agriculture; Commerce; Health, Education, and Welfare; and Interior; and the Federal Power Commission; and the Governors of the applicable States to cooperate with the Corps of Engineers in each separate basin investigation. The organizational device for regional committees could take quite different forms and membership representation depending on such factors as areal extent of survey, existence of going inter-agency committees such as the Missouri Basin Inter-Agency Committee, the Arkansas-White-Red Basin Inter-Agency Committee, the Columbia Basin Inter-Agency Committee, the Pacific Southwest Inter-Agency Committee, the California State-Federal Inter-Agency Committee, and other similar groups. Where such groups exist in an area it would seem reasonable to expect that Federal and applicable State representatives now serving on such an inter-agency group would be assigned to also serve on any regional committee established to cover a basin study assigned to the Corps. It also seems reasonable to expect that if a study basin boundaries coincide with those of an existing inter-agency organization that those individual members would be assigned to the regional committee. On the other side of the coin, there may be a few instances where formal regional committees would not be required for accomplishment of our basin planning mission. An example is in an area where an inter-agency group or commission such as the U. S. Study Commission of Texas has recently completed a Type I plan.

5. The various agencies would normally be informed that the Corps of Engineers had been delegated the task and responsibility for making certain comprehensive investigations, and that the Corps would be seeking the cooperation of Federal and State agencies responsible for various functions and activities that might be embraced in a plan for the basin. The Corps of Engineers conceives of its position as being mainly that of a coordinator in the development of a plan which would encompass many functions and activities not within its sphere of authority. The Corps would make the assignments to the cooperating agencies, who would then be expected to assume full responsibility for carrying out these assignments and for the reports and recommendations resulting therefrom. The reports of the cooperating agencies would accompany the final report of the Corps of Engineers, and the recommendations of those agencies would be at

least summarized in the main body of that report. To the extent necessary to bring about the development of a coordinated and harmonious basin plan, to resolve differences between various agencies and interests, or to take into account the views of the States, the Corps of Engineers may, in its final report, make recommendations at variance with those of the cooperating Federal agency. In such an event the report would indicate the differences between the recommendations of the Corps of Engineers and that of the cooperating agency. The Corps would provide funds to cooperating Federal agencies for carrying out such parts of the work assigned them as these agencies would not otherwise undertake during the planning period. Each Federal cooperating agency may also invite State cooperation within the scope of that agency's assignment. It is probable that in addition to the Corps of Engineers the following agencies would be concerned with most of the investigations.

a. Department of Agriculture
   - Soil Conservation Service
   - Forest Service
   - Agricultural Research Service

b. Department of Health, Education, and Welfare
   - Public Health Service

c. Department of Interior
   - Fish and Wildlife Service
   - National Park Service
   - Bureau of Mines
   - Geological Survey
   - Southwestern Power Administration
   - Bureau of Reclamation (in 17 western states)
   - Southeastern Power Administration
   - Bureau of Outdoor Recreation

d. Department of Commerce
   - Office of Business Economics
   - Census Bureau
   - Area Redevelopment Administration
   - Weather Bureau
   - Bureau of Public Roads
   - Office of Undersecretary of Transportation

e. Department of Labor

f. Federal Power Commission

g. States (applicable agencies)

6. For the purpose of resolving problems of mutual interest to several Federal agencies or Federal agencies and States, administrative devices would have to be established at the field level, generally with the representative of the Corps of Engineers providing the leadership. The main functions of these groups would be to make periodic examinations of the progress being made in the various studies, to discuss the problems of mutual interest, and to assist and advise all participating agencies. It is in this area of interest that the rest of this paper is addressed to and the comments thereon are intended in general to be within the framework of regional basin study coordinating committees covered above. However, a good deal of the information, comments, and views expressed in the following paragraph are also applicable to regional committee aspects of our planning effort.

WORKING WITHIN THE REGIONAL COMMITTEE FRAMEWORK

7. In consideration of methods of approach to cover the general subject of participation of others within the framework of regional basin committees, it appears that two alternatives have the most merit. The first is to try to cover participation with each individual Federal and non-Federal agency, private groups, and other planning interests connected with an effort of this kind. This method has certain definite advantages but this particular angle focuses efforts on a comparative analysis of a long list of agency responsibilities that have already been covered rather extensively in the literature and in forum discussions. Individual agency treatment has its limitations as there are tendencies in excessive compartmentalization where attention can be easily directed to the trees rather than the forest. An item that bears on this matter, too, is that later in the seminar the contributions of the individual Federal agencies and the roles of the states will be covered by separate papers. This leads to the second approach - a treatment of the broad phases of participation effort with others in the water resources planning field. This approach seems more realistic because planning on a broad front under today's concept is complex and represents bringing bundles or collections of individual agency efforts into an integrated package in the interest of the most good for the greatest number of people.

8. An important part of moving ahead under today's concept of basin planning involves what might be called good "philosophical engineering" or maybe better the right "attitudes for planning." This aspect of our participation with others needs to be sharpened more than any other. We should better understand the whys and the wherefores of dissimilar views and interests in the water resources field. Then the problems before us can be comprehended more fully

and we can thereby be in a better position to be more efficient in our leadership in the resolvement of dissimilar views and the working out of equitable solutions to human problems to the same high degree of efficiency with which we solve engineering problems. A brief summary of the Corps' role in basin planning should help to establish what historical and present-day events in the planning field have motivated our efforts and our philosophy or attitudes in the water resources field.

9. For more than a half-century the political leaders and more thoughtful citizens of the United States have been striving to grasp, assess, and, during the latter part of that period, put into effect a fundamental concept first clearly enunciated during the "conservation crusade" of President Theodore Roosevelt's Administration. This concept is, in brief, that each of the major river basins should be developed under a single comprehensive plan, multiple-purpose in scope and consolidating all developmental activities within the basin into a coordinated whole. Over the years this basic idea has won the commendation and support of the official bodies established from time to time to advise the Government on resources development. But progress in incorporating this concept into the law and into the programs of the Federal agencies has been halting and painfully slow. It now appears that a firm decision has at last been reached. Both the Congress and the Chief Executive have called for the preparation of comprehensive unified plans to guide the development of all of the Nation's great river systems. The planning agencies of the United States are therefore confronted with a planning task of unprecedented magnitude and difficulty.

10. Under today's concept, comprehensive plans for the development of the Nation's rivers should be designed to meet national, regional and state goals. The primary goal must be the protection and enhancement of the welfare of its people which the people need if they are to live healthy, happy, and productive lives. Basin plans can be roughly correlated with the growth of the Nation's wealth, which, in turn, may be either accelerated or slowed down by the rate at which the potentials of its rivers are developed. Plans adequate to meet modern needs, and to comply with modern concepts of resource development, must be based upon a modern philosophy of planning. Such a philosophy, growing out of the Corps of Engineers' many years of experience, includes a cardinal principle that basin planning is a team job. Many agencies, institutions, and non-public groups must be brought into the development of comprehensive plans if they are to have balance, meet all important needs, and be generally accepted. The participants represented on basin planning teams must be willing to cooperate with each other in planning, and to adjust their roles to the nature of the basin's potentials and problems, as well as to

the capabilities of other members of the team. Experts in many disciplines, and especially in the economic field, can make important contributions to such plans - formulation of comprehensive river basin plans is not a job for the engineer alone. The technical and economic participants assigned responsibility for formulating such a plan should limit themselves to objective considerations of the technical and economic aspects of the task, and any necessary consideration of political factors should generally be provided by District and Division Engineers rather than those charged with preparation of the plan.

11. It was not until 1950 that Congress actually directed that the regular agencies of the Executive Branch prepare a truly comprehensive river basin plan. This directive was included in the Flood Control Act of that year, and called for a survey under then-existing Federal policies and procedures of the region drained by the Arkansas, White and Red Rivers, all to be coordinated with the Department of the Interior, the Department of Agriculture, the Federal Power Commission, other appropriate Federal agencies and with the States, as required by existing law. The same Act called for a similar, but less intensive, study of the New England-New York region. These studies were made by inter-agency committees operating under the chairmanship of the Corps of Engineers. This resulted in "framework" (Type I) plans of great value for guiding and coordinating future developments in the two regions. The Corps of Engineers in 1956 initiated the formulation of a detailed comprehensive (Type II) plan for the Delaware River Basin, with the full cooperation of the other Federal agencies and the States. This plan was submitted to Congress and the carrying out of certain parts thereof was authorized by the Flood Control Act of 1962. A similar plan for the Potomac River Basin, formulated by use of a generally similar technique, is nearing completion at this time. In 1958 Congress authorized the establishment of U. S. Study Commissions to make comprehensive plans for the river basins of the southeastern region and Texas. This has resulted in the completion of a framework (Type I) plan for the Texas River Basins. A similar plan for the southeast is nearing completion. The Study Commissions serve as agencies to coordinate the planning work of the existing Federal and State agencies.

12. When the Government first began to provide civil works - then mainly transportation facilities - necessary to development of the young Nation's vast potential economic strength, it called upon the Corps of Engineers. Although the Corps had previously made surveys and studies, the first appropriation for actually carrying out a Federal civil works project was not made available to it until 1824 when Congress authorized the improvement of the Ohio and Mississippi Rivers by the removal of snags obstructing navigation.

13. During the ensuing 139 years a major part of the Federal Government's growing responsibilities in the field of water resource development has been assigned the Corps of Engineers. Even when the services of other engineering organizations became available to the Government, it continued to rely mainly upon the engineers of the Army for the planning and carrying out of the Nation's major public works. This in itself is an indication that the Corps of Engineers has discharged its civil works assignments with efficiency and integrity.

14. As the Federal agency bearing the principal responsibility for developing the Nation's water resources, the Corps of Engineers has, also quite naturally, been the leading Federal planning organization in the water field. At the outset the Corps was called upon to develop plans for individual harbor and waterway projects. But over the years the Federal Government progressively assumed wider responsibilities and the scope of Corps' plans broadened correspondingly. This evolutionary process set the stage for the 1961 report of the Senate Select Committee. That report appears to have been the final action required to open the door to a new era in the field of water planning. There is no longer any question but that future development of the Nation's river basins will be guided and coordinated by comprehensive and unified plans, designed to bring about multiple-purpose development of their resources. As the Nation enters this new planning era, serious consideration is being given to the best way to arrive at such comprehensive plans.

15. Following up on the President's call for implementation of the Select Committee's recommendation that comprehensive plans be completed by 1970, the Chief of Engineers then developed a tentative program of future basin planning. This program was based upon recommendations of his Division Engineers, and encompassed not only the development of the framework, or Type I, plans required to meet the President's immediate objective of nation-wide coverage by 1970, but also the preparation of the detailed Type II plans that would be required to complete the total basin planning job to the extent that needs can be foreseen at this time.

16. The Corps of Engineers has the only nation-wide organization possessing know-how in the field of comprehensive river basin planning. It has 11 Division Offices and 38 District Offices staffed to undertake planning in this field. The Corps also has 139 years of experience in dealing with the development of the Nation's rivers. Over that period it has assembled a vast body of data on all of the rivers of the United States. No other Federal agency has had comparable experience in the actual preparation of comprehensive river basin plans. The experience gained in the Arkansas-White-Red and the New England-New York joint planning efforts provides an extremely valuable

understanding of the scope and nature of framework (Type I) plans, and of the problems which arise in cooperative development of such plans. The experience in developing Type II plans for the Delaware and Potomac Basins will also be invaluable to the Nation in the new planning era just now opening.

17. However, as stated hereinbefore, the Corps of Engineers is strongly convinced that the planning task set by the Select Committee and the President cannot be successfully accomplished without the use of all of the know-how, all of the information, and all of the planning personnel now available to the Federal and State agencies and others concerned with the various facets of comprehensive basin plans. Moreover, the Corps believes that it is in a position to provide leadership in the formulation of such plans.

WHY DIFFERENT VIEWPOINTS

18. From a pyramiding of statutes for over 139 years, various important policy declarations and laws have been embodied in different legislation. Each addition has usually dealt with the most pressing need current at that time. In large measure each of the needs has been treated separately as it has arisen, and separate administrative machinery has been established to take care of it. As stated before, in recent years there has been a trend toward multiple-purpose and basin-wide comprehensive development as expressed and implemented in various Congressional statutes which were passed at different times and devoted to the separate phases of development, and administrated by separate agencies. The steps taken legislatively have permitted the construction of multiple-purpose and basin-wide plans but without altering substantially the underlying bodies of separate law which are largely articulated with the principal water resource purposes and different localities. And since the underlying bodies of law have remained unchanged, a complete composite of these separate and differing statutory provisions constitute the law applicable to present-day situations. Within this framework of applicable law, the Corps must provide leadership in the field of comprehensive basin planning to weld plans and programs in the most efficient way to develop the water and land resources to best serve the needs of the people.

19. In the past there have been charges of conflict, duplication and waste in the administration by Federal agencies of the water resources program in the United States. Honest difference of opinion has existed between administrators, agencies and individuals as to the water resources program of the United States. In spite of conflicting agency policies, views and interest, there has been a steady and sound advance in joint efforts by planners. The significant areas of disagreement between Federal agencies is relatively small. The real

difference between executive agencies and, indeed, within a single agency stems for the most part from inherent differences in the requirements of the various water users which, in turn over the years, has developed into differences in legislative and administrative procedure under which each agency operates. Fundamentally, it reduces to the realm of differing social and welfare views that are exemplified in existing water resources laws, Congressional committee organization and related channels in the Executive Branch.

20. In addition to the Corps project purpose responsibilities, numerous other agencies participate in water-resource development on a project purpose basis. The Bureau of Reclamation operates in the 17 western states, primarily in the irrigation and conservation aspects of water resources planning. The Department of Health, Education, and Welfare is primarily concerned with water quality control and works with the Corps on establishments of needs and demands for water supply for municipal and industrial purposes. The Bonneville Power Administration, the Southeastern Power Administration, and the Southwestern Power Administration of the Department of the Interior are marketing agencies for the electricity generated at multi-purpose systems in these areas. The Tennessee Valley Authority has almost sole jurisdiction over all phases of water-resource development in its region. The Soil Conservation Service of the Department of Agriculture runs a program of flood control on small upstream tributaries and on rivers that are off the main stream. The Indian Service is in charge of all developments on land set aside as Indian reservations. The Federal Power Commission has general regulatory authority over hydroelectric power development, and supplies the basic market studies which determine the need for the power output of all Corps of Engineers' projects. And many other agencies[1] and state planning agencies enter the picture in various incidental ways, usually on a functional basis.

21. With the exception of the TVA, each of these agencies has a traditional function which was entrusted to it by the Congress. The administrative organization of federal water-resource activities is defined in terms of functions rather than of areas such as river basins. Since the development of most rivers is of a multi-purpose nature, involving several functions, it is an absolute necessity in comprehensive basin planning to get some workable form of participation from these agencies and from the state and local interests groups

[1] Over 102,000 separate types of governments existed in 1957 according to the U. S. Bureau of the Census, 1957 Census of Governments, Volume 1, No. 1, pp. 1 and 15.

within the regional committee setup. This can be accomplished in infinite ways. The real problem is one of devising a planning mechanism through which various interests can be equitably represented and no group of interests can dominate the formulation of the plan.

WHAT DEVICE TO USE

22. The most productive type of society is the kind of diversified society which exists in our country today. However, the splintering effects of interest run counter to the practical maxims of pure efficiency in operations and in the decision process. There are several arrangements that can be provided for compounding different interests into a working formula for the pursuit of the common good. The specific arrangement will or may differ from area to area, and differ because of scope objectives (Type I or II studies). A regional inter-agency group for each major basin would generally be the first step in setting up the machinery to get the broad objectives in focus. Then within this apparatus is the machinery of ad hoc committees, work groups, coordination committees, collaboration committees, inter-agency planning staffs, and most importantly, the long established agency-to-agency arrangements. The perspectives of individual agencies who have their roots in functional project purposes can best merge their perspectives into an across-the-board viewpoint through the framework of continuously acting coordination machinery that can easily be established through existing administrative arrangement. However, the Corps must maintain constant surveillance on a systematic basis throughout the study and not on a two-time basis - as at the beginning and end of the study. Reconciliation is accomplished, however, not by command but by efforts at meeting of minds on a day-to-day basis. The end product may not be perfect but by earnest effort, solutions will be developed which can largely be accepted by all concerned with no group or interest dominating the development. No device and no mechanism can automatically do the trick. This is a matter of unwavering determination of all concerned to get the job done.

23. The variances in the interest, capacity, and methodology of various agencies and planning groups involved require that the internal physical arrangements we develop for individual basins to accomplish proper coordination must allow plenty of room for novel and unexpected forms. It is probable that the more flexible we are in arrangements the better off we will be. The dissimilar physical and social conditions and status of work accomplished to date suggest that arrangements that may be excellent for one locality may be entirely unworkable in another area. More often than not participation with others can be accomplished best by a small staff of planners representing the major interests in a particular situation. In certain circumstances

the planning staff should consist exclusively of Corps' representatives. In other circumstances it may be highly desirable to establish a planning staff of Corps' and other agency representatives. Individual Corps' participants should operate on a full-time basis for a particular basin. Assignments must be fluid and delegation to the normal institutional working levels should be encouraged. Where the technical work cannot be accomplished through going institutional machinery, it may be desirable to establish ad hoc or standing work groups, collaboration committees, coordination committees and similar groups with representation from agencies having common or closely related interests. The technical groups would operate under the direction and guidance of the planning staff. The small planning group should be "broad-gauged generalists" rather than technical specialists. Planning staff committees should consist of high-quality persons that are willing and patently identified with goals established by the President, devoting their efforts to securing policy and administrative cohesion within the framework of existing agency structures. Their major concern should be long-range policy developments and overall plan formulation to see that established goals are met. However, forward planning and current programs must move ahead together. Ad hoc improvisation and spot adjudication are to be preferred to impassable controversial issues.

OPERATIONS

24. Administrative machinery is indispensible but it will not do the job alone. Corps' leadership must remain flexible and keep being recreated to meet the wide range of situations that will be encountered in planning on such a broad scale. Long experience has demonstrated that success in inter-agency planning succeeds in direct proportion to the quality and character of the leadership. In working with others in the water resources field, Corps' representatives should make their leadership felt by the media of persuasion by winning wide public support by making sure that various interests are equitably represented and by being successful in good human relations. We cannot be doctrinaire or unyielding. We must be able to deviate, compromise and draw out creative principles, criteria, and sound engineering projects that represent the one best solution. We may find it desirable to recommend enactment of general legislation to change existing laws that are constraints to good planning and to provide a national framework of policy in such areas as cost sharing, cost allocation, and delineation of responsibilities for further planning and construction of elements of the plan. One of our most difficult jobs is to harmonize conflicting interests of functionally divergent groups. In a pluralistic society it is one of the most crucial tasks of our job, just as it is in most diverse undertakings public and private.

PRESSURE GROUPS

25. And finally, in a democratic society like the United States which has developed a mature economy and well organized private interests groups, any planning body will find itself constantly plagued by opposition units, often of superior influence and prestige. To be an effective planner, the scientist, engineer, etc., must consider the challenge of pressure groups within the context of his specialty if he hopes to make a real contribution to our planning effort. Sometimes slow advance must be made through compromise, by compounding of differences, by trimming of plans, and a suppression of two straight-forward lines. In the final analysis though the Corps in all these undertakings must be entirely answerable for the projects and plans formulated and for its conclusions and recommendations contained in documents submitted to the President and the Congress.

SUMMARY

26. Expressions by participants at the seminar indicated that coordination with Federal and state agencies has generally been satisfactory. There was a consensus, however, that more systematic and diligent coordination will be required at all levels of operations with respect to funding and phasing of work in view of the modified basin planning concept presented by General Penny. The main points presented in subject paper are summarized below.

The real problem we have in coordination with others is one of devising planning mechanisms through which various interests can be fairly represented and no group of interests can dominate the formulation of the plan or a particular situation. The Corps of Engineers conceives of its position as being mainly that of a coordinator in the development of a plan which would encompass many functions and activities not within its sphere of authority.

The administrative organization of Federal water resource activities is defined in terms of functions rather than of areas such as river basins. Since the development of most rivers is of a multiple-purpose nature involving several functions, it is an absolute necessity in comprehensive basin planning to get some workable form of participation from these agencies and from the state and local interests groups. Growing out of the Corps of Engineers' many years of experience is a cardinal principle that basin planning is a team job. Many agencies, institutions and non-public groups must be brought into the development of comprehensive plans if they are to have balance meet all important needs, and be generally accepted.

The variances in the interest, capacity, and methodology of various agencies and planning groups involved require that the internal physical arrangements we develop for individual basins to accomplish proper coordination must allow plenty of room for novel and unexpected forms. It is probable that the more flexible we are in arrangements the better off we will be. More often than not participation with others can be accomplished best by a small staff of planners representing the major interests in a particular situation. Assignments must be fluid and delegation to the normal institutional working levels should be encouraged. It may be desirable to establish ad hoc or standing work groups, collaboration committees, coordination committees and similar groups with representation from agencies having common or closely related interests. Corps' leadership must remain flexible and keep being recreated to meet the wide range of situations that will be encountered in broad scale planning. One of our most difficult jobs is to harmonize conflicting interests of functionally divergent groups. In a pluralistic society it is one of the most crucial tasks of our job, just as it is in most diverse undertakings - public and private.

We should better understand the whys and wherefores of dissimilar views and interests in the water resources field. Then the problems before us can be comprehended more fully and we can thereby be in a better position to be more efficient in our leadership in the resolvement of dissimilar views and the working out of equitable solutions to human problems to the same high degree of efficiency with which we solve engineering problems.

Long experience has demonstrated that success in inter-agency planning succeeds in direct proportion to the quality and character of the leadership.

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Ohio River Division, Corps of Engineers, Cincinnati, Ohio

1. Estimates of the costs of modern comprehensive basin planning studies are essentially of two types; the initial estimate of study costs made for programming and budget purposes, and a refined cost estimate based on a detailed plan of survey. These cost estimates may be further differentiated as to the type and scope of investigation required to fulfill study objectives. The objectives of the study may be the development of a comprehensive framework plan with a general and broad scope for a major river basin or a geographic area comprising a group of river basins where the economic growth and water resources development potential are closely interrelated; or the objectives may be the formulation of a comprehensive plan for development of the water and related land resources of a tributary of a major river or an individual river basin.

2. In the preparation of an estimate of the cost of any type of a comprehensive planning study, it is important that time be taken at the outset to consider in as much detail as possible the effect of the following factors upon study costs:

a. Objectives and required scope of study.

b. Availability of published and unpublished data from Corps of Engineers, other Federal agency, State or other sources.

c. Suitability of available data for study purposes.

d. Type and quantity of additional data that must be compiled and analyzed.

e. Physical and meteorological characteristics of the basin.

f. Existing developments, anticipated extent of needs for additional resource development and potential of basin for additional development.

g. In a program of the magnitude presently contemplated, substantial use of the capabilities of private firms will be required to supplement Federal capabilities. Consideration should be accorded to the difference in cost of work accomplished by hired labor vs. contract.

h. The economic and social characteristics of the basin. These characteristics are of particular significance in arriving at a reasonable order of magnitude of study costs. Knowledge of the basin's socio-economic characteristics is essential in estimating the cost involved in analyzing the public's needs for the products of water resource developments.

Some of the specific characteristics which require consideration include: total population; population density and distribution; the rate and character of economic and social change; location and complexity of industrial development; occupational trends; current trends in land use; recreational habits of the populace; effects of outside forces on the socio-economic trends within the basin; and trends in water use.

i. Extent of participation by other Federal agencies, State agencies and local interests in the investigation.

3. The accuracy of an estimate of study costs is dependent upon the time and money available and the experience and judgment of the personnel responsible for the estimate. Initial cost estimates must usually be made within a relatively short period of time and without specific allotment of funds. The offices responsible for the initial estimates must therefore rely heavily upon experience as a basis for the estimates. The limited experience in modern comprehensive basin surveys leads to the consideration of experience and costs for other and earlier versions of basin planning as the basis for initial estimates of planning costs. However, the vast differences between modern planning studies and earlier versions makes the latter of questionable value as study costs examples. The early "308" reports were made without expensive multi-agency coordination, planning for sequenced long-range development, or the sophisticated planning concepts presently prescribed by Senate Document No. 97. The earlier studies largely dealt with river basins uncluttered with numerous and varied existing developments while modern planning techniques require consideration of all possible alternative undeveloped potentials and, also, possible modifications to numerous existing developments. More recent surveys provide information which may be used as a basis for estimating the costs of individual study features.

4. The quality of the initial cost estimate depends primarily upon the application of sound judgment by experienced planners who are informed on the study area and appreciative of the work and procedures required to ultimately reach the study objectives. Examination of the cost records of completed studies, item by item, provides an initial basis which, after comparison of the characteristics and needs of the study areas may be utilized as a guide. Completed comprehensive studies for which costs are available are those of the Delaware and Potomac River Basins. Knowledge gained in the early development stages of the Delaware Study was utilized in planning and estimating the funding requirements for the Potomac Study. The physical and socio-economic characteristics of the Potomac River Basin differed markedly from those of the Delaware. Therefore, significant variations in the study effort to achieve the desired results were necessary.

5. A tabulation of actual study costs for the Delaware and Potomac Studies, by uniform cost classification items, is shown in Exhibit No. 1. This exhibit includes also the estimated costs for three "framework" comprehensive studies of major river basins and four more detailed studies of smaller river basins that are currently under way or are scheduled for initiation in Fiscal Year 1964. (Exh. No. 1 is p.97.)

6. Study costs are somewhat related but certainly not in proportion to basin sizes. The size of the area, physical characteristics and existing state of development will influence the cost by virtue of the number of potential projects that must be considered and the amount of computations required for project evaluation and comparison. Also the cost will be affected by the variation in meteorological and other natural phenomena; and the number of alternate projects that must be considered in meeting the requirements of "best use", as set forth in Senate Document No. 97.

7. Costs reported for the completed Delaware and Potomac Studies, and cost estimates for other Federal agency participation in the Ohio and Susquehanna studies, which have been obtained after negotiations and are considered firm, have been analyzed with a view to determining if usable relationships between study item costs and basin characteristics could be developed for use as a guide in estimation of study costs. It must be concluded that, at this time, the data available are not sufficient for reliable cost estimating on the basis of relationships of costs to drainage area, number of counties within the basins, population, or other factors. However, as experience in basin planning studies increases and more data from completed studies are available generalized relationships between study costs and basin characteristics such as area and population may be developed. Generally, the basins for which comprehensive investigations have been completed or sufficiently advanced to have firm cost estimates have diverse features and problems. The amounts in many of the individual items comprising the cost estimates may vary widely between the studies. They should not be used as a guide for use in preparing estimates for other studies unless the circumstances pertaining to the items are fully known.

8. Following allocation of funds to a study, planning for the comprehensive basin planning investigations is firmed-up in a plan of survey. This plan is based on detailed and careful consideration of the nature and extent of study features to be undertaken by the Corps of Engineers and on negotiations with cooperating agencies defining the nature, extent and timing of study features to be undertaken by others. Estimates of study costs based on the plan of survey should be of high quality with respect to the total cost and annual expenditures. However, certain relatively expensive study features, such as field surveys, sub-surface investigations, stream regulation studies, project designs and cost estimates, cannot be fully defined until project formulation

studies are well advanced. Accordingly, estimates of study costs based on the plan of survey cannot be considered static but are subject to adjustment as the study progresses. The original estimate should include adequate allowance in the form of a contingency item for indeterminate study features. As the study progresses and the study features become clearly defined the amount of the contingency item may be reduced.

9. As in the case of the initial estimates of study costs, the principal factor entering into the development of a reasonably accurate estimate of study costs based on a plan of survey is the judgment and experience of personnel responsible for development of the plan and the corresponding cost estimate. The judgment of the planner should be supplemented by frequent consultation and exchange of information with personnel of other offices engaged in comprehensive basin planning studies. Admittedly the Corps of Engineers has more than adequate experience in many work features entering into comprehensive basin planning. The features in which experience is limited are multi-agency coordination, planning for sequenced long-range development, evaluation of all possible alternative development potentials and other factors involved in the sophisticated planning concepts presently prescribed by Senate Document No. 97. It is in these areas that exchange of information between planners will be of the greatest value.

10. The cost of reimbursement of other agencies constitutes a large part of the costs of comprehensive basin planning. In the past there has been some difficulty in limiting the extent of these studies and consequent reimbursement costs. Negotiations with other agencies for reimbursable studies should be sufficiently detailed to clearly define the work to be accomplished and to limit the studies to those required to define the optimum plan for the development of the water and related land resources of the basin. The type and extent of data the participating agencies are expected to furnish should be set forth in a mutually agreed upon written statement in the plan of survey or elsewhere. This written agreement should include time and funding schedules. This procedure should be used to avoid possible misunderstandings and as a means of facilitating checking of work progress. The work plan, as set out in the written agreement, should be reviewed periodically to insure that the desired results will be obtained and that unnecessary work is eliminated.

11. Corps representatives should be informed as fully as available data will permit on the details of their own program as to schedule, extent of coverage of the report and of the requirements of the services of the participating agencies when the negotiations begin. Reasonable cost estimates can only be made when the negotiators know what is needed. Constant vigilance during the negotiations and during the course of the studies is required to identify and cull out extraneous studies and investigations that may be of interest and desirable from the viewpoint

of the participating agencies for their programs but not required in the studies which provide the funds. Negotiations should include consideration of study efforts by the Corps of Engineers and other agencies and the outlining of coordination procedures for exchange of information at the working level to avoid insofar as possible duplication of data collecting and processing. It is recommended that periodical reports be made by the participating agencies on their progress by means of oral discussions or by written progress reports.

12. A well thought-out plan of survey for the overall basin planning effort, in which full consideration is given to the type of study required, maximum use of information and data compiled in connection with other studies and investigations by the Corps of Engineers and other agencies and the limitation of study effort to that required to answer the purposes of the study will provide a sound basis for an estimate of cost of the comprehensive basin study. The plan of survey is intended to serve as a study guide but to do the job for a comprehensive basin planning task the plan of survey cannot be stereotyped, but must be tailored to the type and extent of the particular study and to the specific river basin involved. Furthermore, the plan of survey must be acceptable as a study guide for all agencies participating in the study.

13. Cost estimates for comprehensive planning must be made on the basis that planning studies will be limited to the minimum level necessary to identify the general scope and nature of water and related land resource development needs; to define and evaluate projects, for which Federal authorization will be required to permit necessary construction to be initiated within 10 to 15 years from the time of the study, in sufficient detail to provide a basis for authorization; to identify the general nature and scope of the parts of the plan which should be undertaken under non-Federal or other Federal programs to supplement or utilize the projects recommended for authorization, limiting study detail to the minimum necessary to insure that proper balance has been achieved between the two types of projects.

14. Costs of investigations should not be forgotten once the original estimate is made. Further estimates must be made at regular intervals (at least annually) until the final estimate is made as the investigations approach completion. Timely action must be taken throughout the investigations to control all activities so that most efficient use of funds will occur. Study items should be terminated as soon as it becomes apparent that further study will not produce justifiable improvements in the results. The effects of new legislation, Federal regulation and procedures should be immediately recognized and their effects on cost adequately determined. Duplication in study efforts by the Corps of Engineers and participating agencies should be avoided. Frequent joint conferences at the working level between the Corps and participating agencies to exchange information on work progress, data needs, data

ilability and data sources will aid in eliminating duplication of ort. Status of funds and investigations should be compared iodically (varying from monthly to quarterly depending on rate of gress) to determine if any items are progressing unsatisfactorily if the cost is excessive. Only by this procedure can the cost imates be meaningful. Exhibit No. 2 indicates a procedure now used the Huntington District for cost control. Proper use of the data tained in the form should provide sufficient information for timely ion. The Louisville District is now installing an automatic data cessing system whereby cost data for all line items in the uniform t code can be made available to basin planners the same day it is mitted to the Comptroller Organization. These data may be computed ly if desired. (Exhibit No. 2 is page 98.)

15. Study cost estimates will be reported on Form PB-6 using the form cost classification, which comprises the following items:

.01 - Preliminary Planning and Public Contacts
.02 - Hydrology and Mapping
.03 - Surveying and Mapping
.04 - Materials and Foundation Investigations
.05 - Stream Regulation Studies
.06 - Design and Cost Estimates
.07 - Economic Studies (Exclusive of Base Economic and Impact Studies)
.08 - Real Estate Studies
.09 - Special Studies (Includes Studies by Participating Agencies)
.10 - Preparation of Report
.11 - Supervision and Administration

addition to the above items the PB-6 should include a line item for tingencies. This item which may be of the order of about 25 percent an initial estimate should be reduced as the study progresses and dy features such as field surveys, sub-surface investigations, project ign, cost estimates and economic studies become fully defined. The tingency item should also be reduced as unforeseen items appear and included in the study. The contingency item need not cover possible ce level increases.

16. In conclusion it may be stated that initial estimates of study ts must be based on experienced costs for similar studies, modified the judgment of experienced planners. At the present stage of limited erience in modern basin planning the initial estimates for this type study will lack the reality that will come with added experience. The ned estimates of study costs based on detailed plans of survey ared after the studies are funded should be of reasonably high quality. preparation of both types of estimates will be facilitated and the ity of the estimates improved by exchange of information between ning personnel engaged in basin planning studies.

COMPREHENSIVE BASIN STUDY COSTS

		Delaware River Basin *	Potomac River Basin *	Susquehanna River Basin	Kanawha River Basin	Wabash River Basin	Willamette River Basin	Upper Mississippi River Basin	Missouri River Basin	Ohio River Basin
	Study Type	II	II	II	II	II	II	I	I	I
	Drainage Area Sq. Mi.	12,765	14,500	27,500	12,300	33,100	11,200	188,000	530,000	163,000 (1)
	Population Thousands	6,517 (2)	3,000 (3)	2,997 (3)	845 (3)	3,145 (3)	1,200 (3)	10,600 (4)	7,500 (4)	19,000 (3)
	COST ITEMS	COSTS IN THOUSAND DOLLARS								
.01	Preliminary Planning & Public Contacts	$ 168 (5)	$ 89	$ 108	$ 125	$ 130	$ 95	$ 400	$ 260	$ 233
.02	Hydrology	270 (6)	178	272	225	245	90	400	650	633
.03	Surveying & Mapping		66	112	125	170	145	80		30
.04	Materials & Foundation Conditions	296	119	199	190	310	270	120	160	70
.05	Stream Regulation Studies	76	84	122	155	200	175	80	150	607
.06	Designs & Cost Estimates	161	208	311	250	305	215	120	130	100
.07	Economic Studies	110	154	279	190	100	245	665	200	116
.08	Real Estate Studies		29	55	50	60	80	40		33
.09	Special Studies						470			
.091	Flood Damages				110	200				836
.092	Water Supply & Water Quality (M&I)	100	136	(8)	100	340		160	300	138
.093	Fish & Wildlife	77	63	375	100	144		160	200	176
.094	Recreation	80	70	209	100	136		120	300	156
.095	Economic Base Survey	84	35	60	130 (9)	100		280	350	268
.096	Agricultural Water Requirements	127	111	270	140	100		160	225	255
.097	Sedimentation	73	63	300	40	30			150	60
.098	Groundwater				35	270		80		120
.099	Upstream Watersheds	61	(7)	(7)	100	230		150 (10)	575 (11)	100
.0910	Hydroelectric Power	5			150	40		80	225	10
.0912	Navigation				25	125			410	11
.0913	Highway Studies				25			80	40	
.0914	Mineral Studies			448	35	30				
.0915	Miscellaneous Consultants			30						
.10	Preparation of Report	305	164	168	80	210	90	800	350 (12)	240
.11	Supervision & Administration		212	394	120	150	125		250	108
	Total Cost	$1,993	$1,781	$3,712	$2,600	$3,625	$2,000	$3,975	$4,925	$4,300

NOTES: * Completed Studies

(1) Excludes 40,600 sq. mi. in Tennessee River Basin
(2) 1955
(3) 1960
(4) 1950
(5) Includes $36,000 to assemble data and analyze prior reports
(6) Includes $132,000 for Northeast Interim Flood Studies
(7) Included in Agriculture Water Requirements
(8) Funded by Public Health Service
(9) Includes $50,000 for Impact Study - Industry & Tourism
(10) Includes $70,000 for Forestry Studies
(11) Includes $100,000 for Forestry and $300,000 for land management & cover
(12) Includes $100,000 for review of prior reports

Exhibit No. 1

Appropriation: 96X3121 General Investigations
Project: Special Studies

BUDGET REPORT
HUNTINGTON ENGINEER DISTRICT
[X] Civil Activities Military Activities

Reports Control Symbol OVDCB-6
Page No. 20
30 November 1962

Feature of Work	Account Number	Directive Authorization	Current Working Estimate	Funds Allocated to Date	Costs to Date	Funds Available for Work	Additional Funds Required	% of Comp
Kanawha Basin Comprehensive Study								
Prel. Planning & Public Contacts	504.01		150,000.00	25,000.00	847.47	24,152.53		
Hydraulic & Hydrologic Studies	504.02		200,000.00	35,000.00	.00	35,000.00		
Surveying & Mapping	504.03		200,000.00	35,000.00	.00	35,000.00		
Materials & Foundation Investigations	504.04		150,000.00	5,000.00	.00	5,000.00		
Stream Regulation Studies	504.05		100,000.00	.00	.00	.00		
Design & Cost Estimates	504.06		250,000.00	5,000.00	165.41	4,834.59		
Economic Studies	504.07		380,000.00	52,000.00	.00	52,000.00		
Real Estate Studies	504.08		50,000.00	5,000.00	.00	5,000.00		
Special Studies	504.09		775,000.00	.00	.00	.00		
Preparation of Report	504.10		170,000.00	25,000.00	79.93	24,920.07		
Supervision & Administration	504.11		175,000.00	13,000.00	73.22	12,926.78		
Total - Kanawha Basin Study			2,600,000.00	200,000.00	1,166.03	198,833.97	2,400,000.00	

OVD Form 676-R
30 Sep 60

Replaces OVD Form 676-R, Undated, and
OVH Form 657, 28 Dec 54, Which May Be Used

Exhibit No. 2

PLAN OF INVESTIGATION

by
James S. King, Chief, Basin Planning Branch
North Central Division, Corps of Engineers, Chicago, Illinois

INTRODUCTION

Senate Document 97 indicates in effect that the basic objective in the formulation of comprehensive plans for river basins or regions is to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable short- and long-term needs. In pursuit of this objective, full consideration is to be given to each of the following and reasoned choices made between them when they conflict.

a. Development. Water and related land resources are essential to economic development and growth of each region of the country and will contribute to such growth through concurrent provision for adequate facilities, controls, and supplies of water of suitable quality for all water uses.

b. Preservation. Proper stewardship is essential in the long-term interest of the Nation's natural resources. This includes protection and rehabilitation to insure their proper use.

c. Well-being of people. Over-all well-being of the populace of the region under consideration is to be the overriding determinant in considering the best use of water and related land resources.

All viewpoints - national, regional, state and local - are to be fully considered.

Comprehensive planning for a river basin and its associated service area envisions balanced consideration of the above stated objective and its related points in the development of water and related land resources. This requires that the trend and probable extent of basin economic activities be projected and translated into water needs with respect to future time intervals. Upon identification of the needs, comprehensive planning encompasses development of an optimum plan of improvement to meet those needs.

Solutions to problems inherent in striving for optimum utilization of water and related land resources epitomize the need for cooperation and coordination of effort between all levels of Government. Since there are few programs of improvement at any single governmental level which will so markedly produce changes in physical and social environments, it is imperative that a well coordinated, comprehensive and

cooperative approach be developed. This approach requires appropriate consideration of the various pertinent engineering and social science disciplines.

ROLE OF SPONSORING AND PARTICIPATING AGENCIES

In this interdisciplinary, interagency approach, one agency must necessarily be assigned the role of "Sponsoring Agency" and, as such, should be assigned ultimate responsibility for coordinating the study efforts of all participating agencies as a part of the orientation, direction and management of the comprehensive investigation.

Other agencies, Federal, State and local, are then "Participating Agencies", concerned not only with their specific fields of interest but also concerned with cooperative consideration of the relative importance and interrelationship of all water uses.

NEED TO DEFINE STUDY OBJECTIVE

Basic to the development of a Plan of Investigation for a Comprehensive Study is the need for a clear understanding of the broad, general objectives of basin planning; the more specific objectives of the particular study and the criteria which would be used in the conduct of the investigation necessary to realize the assigned mission.

The first concern of the planner, however, when faced with an interagency, interdisciplinary basin planning assignment is not the tools and mechanics of accomplishing the task, but rather the study objective itself. Since the specific study objective must be appraised within a more general frame of reference for conducting basin investigations, it is both logical and purposeful that, as we consider the tools and techniques of planning, we also consider this frame of reference with respect to purpose, approach and scope -- because only through an understanding of the study objective and its relation to the over-all program can an adequate Plan of Investigation be developed and used effectively.

PLANNING PROBLEM

How then can we provide and maintain needed orientation, direction and management of such a complex interdisciplinary effort possibly extending over a period of two to five years or more? Such comprehensive consideration not only requires "planning for planning" in order to properly orient the study, but it then requires continuous effort on direction and maintenance of coordination of all studies required to meet the study objective.

PLAN OF INVESTIGATION

The planning effort can best be accomplished through development and use of a dynamic Plan of Investigation, generally acceptable as a guide for all participating agencies and tailored to the type and scope of the particular study. Such a document, to be useful in pasin planning, must far exceed in purpose, scope and detail, the Plans of Investigation (Survey) which have traditionally been prepared for survey reports, and in many cases have not actually served the purpose for which they were designed.

Study Management Tool. The primary function of the Plan of Investigation is considered to be that of study management. Within the context of this presentation, study management means orientation, direction and coordination of an interdisciplinary effort.

Direction of the study effort must be guided by good management principles. This includes progressive goals with continuing emphasis on (1) Planning, (2) Organizing, (3) Activating, and (4) Reviewing. To be more specific, this means:

(1) Planning through complete exchange of views leading to study orientation and depth, including preparation of a tentative report outline;

(2) Organizing for the study effort through delineation of responsibilities and preparation of time and cost schedules;

(3) Activating the complete study effort; and

(4) Maintaining continuous review of progress and direction of the investigation.

Characteristics. In order to permit consideration of this tool, with respect to its usefulness and adequacy in serving its management purpose, certain aspects of a Plan of Investigation are considered to be worth of comment. These are:

Objectivity in viewpoint
Foresight and imagination in preparation
Flexibility in its use

a. Objectivity in Viewpoint. Planning for a comprehensive basin study must be objective rather than subjective in viewpoint. Such objectivity will permit a comprehensive public viewpoint in the planning approach and will enable planners to view a series of events, study elements and ideas impartially and apart from self-conciousness. The problems of developing comprehensive basin plans are too complex to permit any substantial predominance of provincial views. Therefore, through an early and continuous exchange of views on all aspects of the investigation, the role of each participating agency (Federal, State and local) in the study should be defined. In addition, a mutual understanding of the contribution that can

and should be made to satisfy the requirements of the specific field of interest as an integral part of the over-all study can be obtained. Direct field level discussions by professional planners is the means by which this can best be accomplished. Although the mechanics of this procedure must necessarily be suited to each study effort and personnel involved, the importance of an early and clear understanding of the role of each participant in the study should be emphasized. Such direct exchange of views and delineation of participation efforts will permit a reasonable approach to effective coordination and will certainly add to the chances of an objective planning viewpoint.

b. Foresight and Imagination in Preparation. Comprehensive river basin investigation requires foresight and imagination in planning the approach to the study and in the application of planning techniques. This will require at once bold thinking about, and prudent husbanding of our planning efforts; imagination to see the possibilities in planning for beneficial uses; and care and foresight to insure that our planning resources and efforts are not wasted and so fall short of our study objective. The development of a sound plan of investigation to encompass the study objectives and complex procedures requires development and continuous review of basic study components by those trained in a variety of professional disciplines as well as those trained in the legislative and public administration fields. Professional planners must have a basic perspective and concept of the investigation, the interrelationship of specific studies, and they must be cognizant of the implications - - physical, economic and sociological - of the development of water and related land resources.

c. Flexibility in Use. Planning for the development and use of water resources for 50-100 years in the future is not an exact science. Procedures are available as guides in these planning efforts, but judgment by experienced engineers and social scientists is needed in the application of these procedures to avoid unwarranted and costly details and precision.

In any planning process, and particularly in basin planning efforts extending over several years, plans for investigation require modification as the study progresses to recognize changed conditions and in extreme cases even changed orientation of the study. It therefore must be strongly emphasized that planning for and management of a water resource investigation must mean not rigidity, but intelligent flexibility. One way to maintain such flexibility is to develop the Plan of Investigation in three phases:

(1) Procedural Plan for Investigation. The Procedural Plan is a brief general statement of the study objective, authority for and scope of the investigation, and the interagency coordination required to accomplish the investigation. Its only purpose is to form a basis for initial coordination discussions with all cooperating agencies. It

should be written in brief, but clear, non-technical language. The format and content of the Procedural Plan would vary with each type (I, II, III) of investigation and with specific local conditions. The Outline (Inclosure 1) is presented only for discussion as an example of appropriate subject matter to be included in this initial coordination effort.

(2) Tentative Plan of Investigation. The Tentative Plan of Investigation is an integrated study outline resulting from the coordination of all views and expressed as a logical sequence of investigation elements needed to meet the study objective. The outline and content are based on EM 1120-2-101, with some modification considered appropriate for basin planning. It should contain a detailed time schedule and cost estimate correlated with the investigational elements and reflecting agency responsibilities and a detailed outline of the final report and appendices. This tentative plan would be submitted to the basin Coordinating Committee for comment.

(3) Plan of Investigation. The Plan of Investigation, a refinement of the tentative plan, would be developed after all views have been expressed through the Coordinating Committee. Inclosure 2 is a suggested Plan of Investigation and is presented only for discussion for use in comprehensive basin planning. As an integral part of the Plan of Investigation, management tools, such as Program Evaluation Review Technique (PERT) or the Critical Path Method (CPM) Network operation are considered directly applicable to comprehensive basin study scheduling as expressed by plans of investigation. Up-to-date time schedules and cost estimates for long-term comprehensive basin studies are considered indispensable to efficient study management. While recognizing that a cooperative river basin investigation may not lend itself to the degree of rigid control, as in the case of some other types of projects, the use of these procedures to quickly evaluate modifications in study elements as to the impact on time and cost, is worthy of consideration as an effective tool in implementing the Plan of Investigation.

SUMMARY

The primary function of the Procedural Plan - Plan of Investigation sequence in Comprehensive Basin Planning is management of the study. To perform this management function in an efficient manner, it is all important that the Plan of Investigation clearly presents the results of objective interdisciplinary planning and permits ample opportunity for continuous review of progress throughout the entire investigation. It then becomes, in effect, the communication tool of management by which personnel of all participating agencies are able to understand the overall study, its purpose, scope and progress.

2 Incl
1. Procedural Plan, page 104

PROCEDURAL PLAN FOR INVESTIGATION

I Authority
II Basin Description
III Basin Water and Related Land Resources Problems
IV Objective and Type of Investigation
V Elements of Investigation
VI Role of Participating Agencies and Coordinating Committee
VII Time Schedule of Investigation

Inclosure 1

PLAN OF INVESTIGATION FOR COMPREHENSIVE BASIN PLANNING

I Synopsis

II Authority

III Basin Description
Physical
Economic

IV Improvements Desired by Local Interests

V Basin Water and Related Land Resources Problems
Resume of Existing Conditions

VI Current Status of Water and Related Land Resources Development in Basin
Planning
Construction

VII Objective of Investigation
Indicate Purpose, Scope and Type (I, II, III)

VIII Policies and Basic Assumptions
Basic Principles (Economic Life, Water Uses, Federal, State and local responsibilities, etc.) Applicable Constraints and Controls

IX Summary of Available Data
Engineering, Economic, Conservation, Sociological (Prepared by all Cooperating Agencies)

X Elements of Investigation
Include Summary of Appropriate Field and Office Studies by each Cooperating Agency Required for:
a. Appraisal of Basin Capabilities and Potential
(1) Inventory of Resources
(2) Economic Base Study
(3) Engineering Studies
b. Water Needs Determination
c. Water Availability Evaluation
d. Development of Time Phased Plan, including Alternatives, to meet needs (either Framework Plan or Detailed Plan).

XI Participating Agencies
Name and Responsibilities for Investigation in Specific Field Interest

XII Coordinating Committee
Purpose, Procedures for Investigation and Public Hearings
Procedures for Effecting Field Level Coordination

XIII Report Outline
Include Detailed Outline of Main Report

XIV Schedule of Cost Estimate of Investigation
Over-all Schedule should be detailed by elements of the Investigation and by contributions of each Participating Agency
Include the PB-6 cost breakdown with a further breakdown of special (Cooperating Agency) studies. Also included should be PERT or CPM Operating Network delineating each detailed element of the investigati

Inclosure 2

710-215 O-63-8

XV Procedure for report submission to higher authority
Review by Coordinating Committee, each agency and department
XVI Recommendation for approval

5 Attachments
1. Detailed Outline of Study of each participating agency
2. PB-6
3. Sequential Operations Program, (PERT, CPM or other)
4. Report Outline
5. Maps or Drawings

ROLE OF THE DEPARTMENT OF THE INTERIOR IN RIVER BASIN PLANNING 1/

It is appropriate to review briefly the objectives or general philosophy of the statement on Policies, Standards and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources, approved by President Kennedy on May 15, 1962, to provide background for considering the responsibilities of the Department of the Interior in river basin planning. This will be followed by a statement on the role of the Department in such efforts as now implemented through the investigations and other activities of the eight and, in certain regions, nine bureaus and offices concerned which relate to river basin planning and as coordinated through the regional Field Committees and Regional Coordinators.

The new standards clearly state that the over-all objective in the formulation of plans is to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable short- and long-term needs. In pursuit of this basic conservation objective, full consideration is to be given to three major concerns:

(1) Development of resources as an aid to national economic development and development of each region within the economy;

(2) Preservation of resources, in appropriate instances, to insure that they will be available for their best use when needed;

(3) Well-being of people. Well-being of all the people is to be the overriding determinant in considering the best use of water and related land resources.

The statement on standards requires that planning for the use and development of water and related land resources shall be on a fully comprehensive basis so as (1) to consider the needs and possibilities for all significant resource uses and purposes of development, including but not limited to:

domestic, municipal, agricultural, and industrial uses of water;

1/ Paper prepared as background for participation by Henry P. Caulfield, Jr., Assistant Director, Resources Program Staff, Office of the Secretary, Department of the Interior, at Corps of Engineers Seminar on River Basin Planning, May 28, 1963. The paper was largely prepared by Miss Isabel Picken, Staff Assistant, Resources Program Staff.

water quality control;

navigation in relation to the Nation's transportation system;

hydroelectric power;

flood protection control or prevention;

land and beach stabilization;

drainage, including salinity control;

watershed protection and management;

forest and mineral production;

grazing and cropland improvement;

outdoor recreation, as well as sport and commercial fish and wildlife protection and enhancement;

preservation of unique areas of natural beauty, historical and scientific interest;

and (2) to consider all relevant means (including nonstructural as well as structural measures) singly, in combination, or in alternative combinations reflecting different basic choice patterns for providing such uses and purposes.

In the statements of planning objectives the possibility of conflict between the objectives is recognized. In particular, such conflict may be most intense between the goals of development and of preservation. Nevertheless, planning agencies are required to give full consideration to all objectives. When there are major differences among technically possible plans conceived as desirable on basis of consideration of intangible benefits and costs, in comparison with optimum plans based on tangible benefits and costs, alternative combinations of projects or alternative projects are to be planned and planning reports are to clearly indicate the alternatives and the consequences of the alternate plans. To our knowledge, the first effort to fully implement this injunction is now underway in the joint Interior-Army survey of the Upper Missouri River Basin. In this survey, eleven alternative plans for development of the resources of the area have been studied and all eleven will be reported including the benefits they will provide and the cost of providing those benefits. It is anticipated that the field level report will include recommendation that a lesser number of alternatives should be given further consideration. It will, nevertheless, report

a variety of alternatives ranging from full development of the head of this reach of the river for hydro power production to the minimum development required to maintain the river as a wilderness waterway.

The choice among plans within the Executive Branch, as well as the first choice of the Congress, is a political choice in the proper sense, that is, a choice based upon consideration of all aspects of the public interest.

The Department of the Interior has been characterized by some as the conservation agency of the Federal Government. Although there are several conservation functions for which other agencies of the Federal Government have major responsibility, it is a fact that the range of responsibilities in the conservation field which have been assigned by law to this Department is very broad. The total activity of the Department of the Interior is undoubtedly weighted more heavily toward natural resource conservation than that of any other Department. Among other things, this Department has major responsibilities in the conservation areas of fish and wildlife, recreation, public lands, territories and island possessions, Indian interests, minerals including oil, and in water resources. To some extent, all agencies of the Interior Department are concerned with development of water and related land resources but the Bureau of Reclamation has a major responsibility for such programs.

The activity of the Bureau of Reclamation is limited by law to the 17 western States and some activity in the new States of Alaska and Hawaii. When it was first authorized in 1902, the Reclamation program was concerned directly with the provision of irrigation water to arid public lands. The objective of the program was to make those lands suitable for settlement and thus provide an economic base for the development of the arid portions of the western States. During the 60 years since its inception, the Reclamation program has been broadened to include numerous additional functions: commercial hydroelectric power, municipal and industrial water supplies, flood control and navigation, fish and wildlife enhancement, water quality control and, in some cases, recreation. There is no general recreation provision yet, which applies to the Department of the Interior, such as that applicable to the Corps in section 4 of the 1944 Flood Control Act. To date, recreation at Reclamation reservoirs has been authorized on a project-by-project basis. In the last six to eight years, individual project authorizations have provided for minimum basic facilities to be developed as a part of the Federal project cost with the objective that these facilities would be operated largely by non-Federal public bodies. In some cases where the reservoir is located in a National Forest such facilities are operated by the Forest Service. At reservoirs where National Recreation Areas have been authorized, they are planned and operated by the National Park Service.

In many respects, the program of the Bureau of Reclamation is similar to that of the Corps of Engineers. The notable differences are (1) that the area of operation has been confined to the western states; (2) that the Bureau's program has been primarily concerned with functions that are traditionally reimbursable; and (3) the Bureau of Reclamation has responsibility in large regions of the country for marketing power generated at projects constructed by Federal agencies.

In addition to the Bureau of Reclamation, there are three other power marketing agencies in Interior: the Bonneville Power Administration, Southwestern Power Administration, and Southeastern Power Administration, each having comparable responsibilities for marketing of power in specific regions of the country. Although not responsible for planning or implementing water resources development programs, these three agencies are directly concerned with power market studies and with plans for the size and type of power installations at Federal dams in their market areas in order to meet their responsibility for marketing the power in accordance with the requirements of law and executive orders which control their operations. In the remainder of the country, the staff of the Assistant Secretary for Water and Power Development in Washington is similarly concerned.

With the exception of the Bureau of Reclamation and the three power marketing agencies, all Interior agencies are authorized to conduct operations throughout the United States, i. e., have nationwide responsibilities. As a practical matter, the programs of two of the agencies, the Bureau of Land Management and the Bureau of Indian Affairs, are concentrated in the western part of the country. It is obvious why this is so in the case of the Bureau of Land Management, which is responsible for the management, protection, and disposal of the public lands, since most of the 467 million acres of such lands are in 11 western states and Alaska. Similarly, most of the groups of Indian people live in states west of the Mississippi River.

In neither the Bureau of Land Management or Bureau of Indian Affairs programs have comprehensive river basin investigations constituted a very significant portion of the total agency effort to date. In certain areas, particularly the Missouri River Basin, the Bureau of Land Management has advanced the land classification studies of the public lands more rapidly than in other parts of the country. The Bureau of Indian Affairs has placed emphasis on the problems of adjustment of Indian groups when their lands and resources will be purchased to permit construction of water resources developments. The major efforts of the Bureau of Indian Affairs program are directed toward the education, welfare of the Indian people, and management of resources on Indian lands. Increasing emphasis is being placed on improving economic opportunities for the Indian people.

Similarly, all other Interior agencies involved in comprehensive river basin investigations in greater or lesser degrees, have programs which focus on specific resources, i.e., are functionally oriented, while river basin planning efforts are essentially area-oriented. The Geological Survey, Bureau of Mines, Bureau of Sport Fisheries and Wildlife, Bureau of Commercial Fisheries, National Park Service, and the Bureau of Outdoor Recreation will now be discussed briefly from point of view of their present roles in river basin planning.

Geological Survey--Most of the programs of this bureau, the geologic and mineral resource studies, topographic and geologic mapping and water resources investigations, provide a wealth of background information or basic data which is used extensively in comprehensive river basin planning. Programs in water resources cover a wide spectrum of activities from the basic data collection, including streamflow data, water quality data, and ground water levels, through interpretive and analytical studies of the resources to research in the various phases of the hydrologic cycle. In addition to these broad programs, which are supported by direct Federal appropriations and oriented toward national needs, the Geological Survey is requested from time to time to do specific work, usually in support of specific public works projects. The Geological Survey performs stream-gaging work for the Corps of Engineers on a continuing basis in an amount exceeding $1 million during the current fiscal year. While much of this stream gaging relates to the responsibility of the Corps of Engineers for operation of their river basin projects, some relates to investigation activities of the Corps. There is an agreement between the Survey and the Corps covering this continuing stream-gaging program.

On the basis of bilateral negotiations, the Survey also conducts a variety of special investigations for water resources agencies which are directly concerned with river basin planning. These include ground water studies, sediment studies, water quality studies and, in some cases, stream-gaging studies. Occasionally the Geological Survey is asked to provide a consulting service covering other phases of specialized competence, especially geologic knowledge. These special investigations are usually funded by a transfer of funds. Infrequently the Survey has been able to perform the services without charge. At other times there is cost-sharing, particularly where the Survey wishes to conduct the program in a broader scope than is required solely to satisfy the planning agency's needs.

Bureau of Mines--As the Federal agency concerned with mineral raw materials and their effective utilization, the Bureau of Mines has been increasingly involved in comprehensive river basin investigations. Mineral resource, mineral economics and

mineral utilization studies have been conducted for both Corps of Engineers and Bureau of Reclamation. Factors involved in such studies include determination of mineral resources in a project area which may become developable as a result of project construction, opportunities for development of previously non-economic mineral development because of power availability or other change in economics as a result of project construction, determination of mineral production subject to inundation or regulation due to reservoir operation, water requirements of mineral industries which may be met through project construction, etc.

The extent and type of investigations required in relation to any specific water resource development will vary widely and depend to a large extent on mineral character of the area. The problem of timing of such investigations so that information is available for the planning agency when needed requires improved coordination of effort.

Fish and Wildlife Service--The Fish and Wildlife Service, which includes the Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries, is concerned with the impact which water resource development programs will have on the fish and wildlife resources. In accordance with the Fish and Wildlife Coordination Act, studies of the impact of such proposed developments are made and measures to mitigate damages and enhance these resources are recommended in authorization reports which are presented to the Congress for action. Such investigations and studies are made in relation to project or river basin investigations of the Corps of Engineers and the Bureau of Reclamation.

This statutory responsibility generally is exercised by the Bureau of Sport Fisheries and Wildlife. Participation in water resource planning includes such considerations as the location and design of structures; control of downstream releases to preserve or benefit reaches of stream fisheries; maintenance of reservoir water levels; land acquisition and development of wildlife habitat; and installation of fish screens, passage facilities, or other specific measures as required.

The Bureau of Sport Fisheries and Wildlife works cooperatively with affected State fish and game agencies and, when commerical fish are involved, with the Bureau of Commercial Fisheries. Fishery aspects of fish and wildlife investigations in the Pacific Northwest are conducted by the Bureau of Commercial Fisheries. In Alaska all phases of river basin analysis relating to fish and wildlife are conducted by the Regional Director of the Bureau of Commercial Fisheries.

Many problems relating to fish and wildlife in connection with the Nation's water development program remain to be resolved satisfactorily. Passage of anadromous fishes over high dams and the return of their offspring to the sea, maintenance of sustained high quality reservoir fishing, and the very serious effects of changes in estuarine habitat on marine fish stocks are among the more pressing problems. For example, many species of sport and commercial marine fishes depend on a particular character of estuarine environment for critical phases of their development. Changes brought about by dredging, altered inflows of fresh water, and pollution are having an increasingly devastating effect. Insufficient attention has been given to date on the changes in estuarine areas which result from changes in river regimen due to water resources development and the impact of such changes on the fisheries which depend on estuarine conditions for nursery areas and growth.

Bureau of Outdoor Recreation-National Park Service--For some years, the National Park Service has been responsible for recreation planning in relation to Bureau of Reclamation multiple-purpose planning and for recreation area planning at Reclamation reservoir projects. With the establishment of the new Bureau of Outdoor Recreation there have been some recent changes in assignment of responsibility for such work.

At the present time, the Bureau of Outdoor Recreation is responsible for assistance in recreation planning in Bureau of Reclamation reconnaissance and basin investigation and reports. The National Park Service will be responsible for the more detailed planning in relation to Reclamation project investigations leading to preparation of feasibility reports as a basis for project authorization.

The reconnaissance and basin reports on recreation developments to be prepared by the Bureau of Outdoor Recreation will include the following: evaluation of the recreation potentials of reservoir sites in terms of the demand for and supply of recreation in the State, region, and Nation; their relationship to known and projected needs, the estimated immediate and foreseeable future recreation use; estimates of benefits and losses to existing recreation values; evaluation of the kind of public use inherent in the reservoir areas; a general estimate of the amount of land needed for recreation; a recommendation as to what level of government should assume administration of recreation; and a broad over-all appraisal of how much Federal funds seem reasonable to spend for development and recreation lands.

The wide range of Interior Department responsibilities in the resources field and the need for relating the functional programs of the separate bureaus and for working out conflicts among

resource uses to the extent possible require that there be some formal mechanism through which coordination of efforts can be accomplished. The Department of the Interior Field Committees at field level and the Resources Program Staff in Washington have this function as one of their major responsibilities. Both are staff organizations which report to the Office of the Secretary.

The first Interior Field Committee, the Missouri Basin Field Committee, was established in 1946 "for the purpose of achieving successful coordination of the Department's program for the development of the land and water resources of the Missouri River Basin and to facilitate cooperation with appropriate Federal agencies and with State and public agencies." Since 1946, the functions of the Field Committees have been re-examined and restated several times but this purpose continues to be one of the basic functions of the Field Committee organization.

At the present time there are six Interior Field Committees: The Alaska Field Committee; Pacific Northwest Field Committee; Pacific Southwest Field Committee; Missouri Basin Field Committee; Southwest Field Committee; and Northeast Field Committee. Each of these operates in the very large region of the country indicated by its name. The President's budget for F.Y. 1964 includes funds for financing two additional field committee chairmen; one for the Upper Mississippi River area and the other for the Ohio River-Appalachian area. It is hoped that the F.Y. 1965 budget will permit employing a Regional Coordinator and establishing an Interior Field Committee in the Southeast Region.

The Field Committee members include the regional directors or ranking regional representatives of all bureaus operating within the designated regions. They are appointed to the Field Committees by the bureau heads and their line responsibilities remain unchanged by appointment to the committees. The Field Committee members and the chairmen are jointly responsible for achieving program coordination within their regions.

The Regional Coordinators of the Department of the Interior serve as chairmen of the Field Committees. The Regional Coordinators are employees of the Office of the Secretary and report to the Secretary through the Resources Program Staff. They are departmental officials as contrasted with bureau officials and their functions in this capacity are staff functions rather than administrative. The Regional Coordinators serve, also, as the representatives of the Department on Field Inter-Agency Committees and other field coordinating committees. By virtue of their continuing working relationships with the regional bureau officials; through the field committee operations, and their direct responsibility to the Office of the Secretary, the Regional Coordinators are especially equipped to be the Departmental spokesmen at field level.

ROLE OF THE DEPARTMENT OF AGRICULTURE IN RIVER BASIN PLANNING

By Gladwin E. Young, Associate Administrator,
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We appreciate the opportunity you have afforded us to explain the Department of Agriculture's concept of its role in river basin planning and development. It seems essential that basin planning be continued on an enlarged scale for many years to come if the future water and land use requirements of our expanding population and economy are to be adequately met. It is, therefore, timely that there should be the best possible understanding of viewpoints, objectives, policies and procedures.

Historical Perspective

Those of us who have been in resource development agencies for some time have had a hand, large or small, in many kinds of river basin planning efforts. Some historical perspective is important to an understanding of the role of the Department of Agriculture in river basin planning and development. Although the Department of Agriculture was created 101 years ago, it was not until 1936 that it became an important participant in river basin planning.

The Flood Control Act of 1936 provided authorization and direction to the Secretary of Agriculture to initiate a program of "investigations of watersheds and measures for runoff and waterflow retardation and soil erosion prevention on watersheds." As many of you know that authorization was the upstream watershed complement to "investigations and improvements of rivers and other waterways for flood control and allied purposes" carried out under the supervision of the Corps of Engineers.

Surveys were made and reports prepared by the Department of Agriculture under the Flood Control Acts for many river basins during the periods 1937-1942 and 1946-1952. During those periods plans for upstream programs were essentially limited to land treatment measures and minor structures for land stabilization. Operations programs were authorized in eleven river basins comprising 31 million acres by the Flood Control Act of 1944. Construction was started in those basins in 1946. Officials charged with carrying out those programs recognized that the measures authorized by the survey reports would provide only limited flood protection benefits. Yet there was strong local desire for more positive flood protection in the small tributaries. As a result, language was included in subsequent USDA Appropriations Acts to authorize use of appropriated funds for both land treatment and complementary structural measures necessary to achieve desired levels of flood prevention in the tributary subwatersheds.

The Department's concept of its role in river basin development has been broadened a great deal since 1948 when the first upstream floodwater retarding structure was completed to supplement a land treatment program for flood prevention in the Cloud Creek tributary of the Washita Basin in Oklahoma. Those broadened concepts of upstream watershed development received immediate and strong public support. By 1950 more than 300 watershed associations and similar groups were seeking help, mainly from the Department of Agriculture, in developing watershed projects for flood prevention and allied purposes. Many national organizations gave strong support to new legislation to extend the upstream watershed program.

The first bill to provide new legislation was introduced by Congressman W. R. Poage of Texas in 1952. Pending legislative action, the appropriation committees in 1953 included $5 million in the USDA Appropriation Act for fiscal year 1954 to start a widespread pilot watershed demonstration program patterned after the work which was being done in the subwatersheds of the eleven basins authorized in 1944. In 1954 the Watershed Protection and Flood Prevention Act, Public Law 566, was enacted. This Act has been further expanded and improved by amendments at nearly every subsequent session of Congress. So that now the Department of Agriculture's role is to assist local watershed organizations with planning and installing land treatment and structural works in upstream watersheds for a variety of multipurpose benefits.

During the past 15 years or so the Department has participated with other Federal and State agencies in many cooperative endeavors for planning water and related land resources development. These cooperative planning efforts were made through several different kinds of organizational mechanisms and in basins with various types of resource problems. Certainly all of us have learned a great deal about cooperative comprehensive basin planning through these and other investigations. Moreover, a substantive amount of coordination has been achieved. Many policies and procedures of Federal agencies as well as points of view of the general public have been harmonized. Yet we are not completely satisfied with the results of any basin investigation in which we have participated. Accordingly, we want to build on, not rest on, these past experiences. We are anxious to cooperate with you and representatives of other concerned agencies to devise efficient and effective ways to plan and carry out the optimum development of the water and related land resources of all our river basins.

Problems ahead for River Basin Planning

So much for the past, let us now consider some of the issues which will have widespread and far-reaching impact on the results to be expected from our future cooperative river basin planning and development.

How comprehensive should river basin plans be is a question not yet defined in general policy statements or actual experience. However, general guidelines for river basin plan formulation have now been established by Presidential action and are published in Senate Document 97, 87th Congress. As we study that document we are convinced that the intended core of river basin planning is the determination of how the water resources in all parts of a river basin shall be managed to serve the needs of all the people. Those needs include the reduction of flood damages, provision of water supply for municipal, industrial and agricultural use, quality control, fish and wildlife development, recreation, hydroelectric power, navigation, preservation of areas of unique beauty and similar purposes.

River basin planning is focused on water management. This is not necessarily an appropriate focus around which all other resource developments or economic developments should be planned. The river basin plan should not be conceived as the master plan for all human activities for a geographic area. Of course, the impacts of water resource development on the total economy of a basin and on total national needs for goods and services are given consideration in river basin plan formulation. Yet, each river basin plan is inherently a "piece-meal" plan from a national viewpoint. Comprehensive river basin plans do not necessarily represent the best overall economic development plan for the Nation when added together. This is not to argue against river basin planning in favor of some super-planning device. We merely seek to establish recognition of the limits of river basin planning.

River basin plans should be formulated with appropriate consideration of the needs for and the effects of use and management practices on both public and private land. Water management and land management are inextricably related. Hence proper management of water begins with conservation use of the land on which the precipitation falls. Quantities and costs of land treatment practices need not be estimated and presented in detail in river basin plans. But conservation use of land should be set forth as a prerequisite for those phases of water management which would be adversely affected by improper land use.

For what period should river basin development be planned is another pertinent question confronting all of us as we expand our experiences in river basin planning.

It is not realistic to attempt to prepare a blueprint for development for all time to come. There are several reasons for not making "one shot" comprehensive blueprint development plans for river basins. The principal reason is that no group of planners

can reliably forecast needs or technological changes over periods of three to five decades. That is the period over which installation of improvements must extend in many basins. There is need for a systematic device for continuous planning of river basin developments.

We must recognize and take steps to preserve today's resources such as our soil, our forests, irreplaceable dam sites and areas of unique natural beauty that might be spoiled for future use if not put in some kind of escrow. But beyond this, one can question the wisdom of seeking authorization in the 1960's for construction of reservoirs and other developments that will not be needed until the 1990's. River basin plans must be flexible guides which are continually revised. Provisions should be made for periodic reviews of basin plans by all interests, including the Congress.

How should the principle of maximizing net benefits be applied? The policies, standards and procedures set forth in Senate Document 97, if appropriately applied, can be the tools through which decision-making officials can weigh the merits of competing uses of water and land and formulate a plan for achieving the least costly development to accomplish desired and warranted objectives. For example, judgment decisions are required to determine if flood control should be aimed at protecting the greatest number of acres, or the greatest number of people, or the greatest amount of property value, the greatest scenic values or some other predetermined goals. Levels of protection that should be provided for urban and agricultural areas require answers that must be partially based on judgment values. Judgment involves more than strictly monetary considerations. A formula for maximizing monetary net benefits cannot supplant informed judgments in river basin planning but can be a useful component of judgments.

Consider the growing national need for water-based outdoor recreation. Is this need best served in any river basin by one or more large reservoirs each with thousands of acres of water surface, by many smaller reservoirs each with 100 or so acres of water surface within a radius of 10 to 15 miles of every point in a river basin, or by some combination of such reservoirs or by a wild river. Tentative judgments on such questions as these should be reached early in the planning process and adjusted as planning progresses so as to maximize net benefits within the river basin by minimizing costs of achieving determined objectives.

We can all agree that the objective of river basin planning should be to provide the optimum of benefits to all beneficiaries within the river basin. In our view, an optimum plan should include contribution to a national policy of providing more widespread dispersal of people and industry in contrast with fostering further concentration in metropolitan areas.

We believe that the solution to the problem of technological unemployment in rural areas is not going to find satisfactory solution in mass movement of rural people to urban centers. Instead, the nation should seek to make more effective utilization of our land and water resources and thus contribute not only to the economic but to the spiritual well-being of our people by bringing new sources of employment to rural areas. These precepts underlie our USDA rural areas development program. They provide the rationals that has led to the strong support for upstream watershed development as a key force in rural areas development.

Now, let us go back to our earlier statement that a desirable set of objectives for a river basin plan should be established and agreed upon by all concerned interests. Economic analysis should be used as a guide to the least cost achievement of the selected goals. If the goals as first established cannot be met within a favorable ratio of monetary benefits to costs, consideration should be given to the importance of non-monetary benefits and/or the revision of the goals. If goals are revised, due regard should be given to the needs of all classes and localities of beneficiaries.

The thesis we are advancing here is quite different from "basin accounting." We are not suggesting that either the economic benefits or the financial returns from one project purpose be used to justify or support another project purpose. What we are saying is that the concept of maximizing net monetary benefits from the national viewpoint does not give the answer as to whether the Nation wants to retain one river in a wild status and one watershed as a wilderness, develop another almost totally for main stem benefits including storage of water now for indeterminate or even unforeseen future uses, or seek some combination of development purposes.

What are the proper relationships between upstream watershed and main stem development. These are much misunderstood relationships. Sometimes there are conflicts between the purposes to be served by development in the two sectors. In other cases inconsistencies in cost sharing are paramount. Usually these relationships have been the root of most problems that have arisen in the long cooperation between the Corps of Engineers and the Department of Agriculture. Let's review, therefore, the principal factors involved in seeking an appropriate answer.

Planning a balanced system of large, intermediate and small dams is one of the most important factors in establishing proper relationships between upstream and downstream developments in most river basins. We contend that nearly every river basin will need some combination of dams of various sizes. That is because main stem dams do not provide benefits above them either for flood protection, or other purposes such as municipal or industrial water, water

quality control, or widely dispersed irrigation or recreation. By the same token, upstream dams often cannot provide the degree of flood protection or the quantities of water needed in downstream areas. Thus upstream dams do not usually compete economically with main stem dams to provide the same kinds of benefits to the same localities. Occasionally there are exceptions. We found an exception in the Cape Fear River Basin, North Carolina. Here a system of 232 upstream dams widely distributed over the approximately 6,650 square mile drainage area above the lowest damage reach on the main stem would provide essentially the same level of flood protection along the main stem as the New Hope Dam on Haw River which would control an area of 1,690 square miles.

Generally conflicts between big dams and little dams are conflicts between beneficiaries. Main stem beneficiaries often get maximum benefits at the expense of upstream interests who are deprived of lands used for main stem reservoir sites. Upstream interests are sometimes deprived of the benefits from the watershed projects when such benefits are considered to be incremental to those provided by main stem dams and are not sufficient to justify upstream development.

A balanced system of reservoirs cannot be developed if different methods of hydrologic and economic analysis are applied on main stem rivers from that used on the tributaries. Neither can a balanced system be developed by the so-called process of incremental analysis if a few major reservoirs are assumed to be the first increment and smaller reservoirs must be justified by the remaining benefits. Naturally the converse is also true. Our objective of river basin planning should be to develop the least costly system to achieve a desired geographic and functional dispersion of benefits within a favorable benefit-cost ratio.

The arguments we have advanced may raise the question as to why we have stressed distribution and allocation of reservoir storage. On the basis of our experiences over the past 20 years, we believe that if this problem can be resolved, the other phases of coordination would fall into place quite readily, or else they would become relatively insignificant.

While we cannot cite any specific river basin where it has been done, unless perhaps the Potomac, we believe that a properly balanced and economically feasible system of dams can be devised to provide optimum benefits within any set of chosen objectives. However, when large numbers of potential dam sites and many water uses are involved the procedural task is quite complicated. Systems analysis offers possibilities for overcoming those procedural difficulties. In the future it may provide a practical tool for rapidly computing from

preliminary site, cost, needs, and potential benefit data the few outstanding or reasonable alternatives. Then those alternatives can be studied in more detail until the best apparent solution under existing conditions and assumptions becomes evident. Econometric models and rapid data processing provide new procedures in planning technology to challenge us. These procedures should be utilized in so far as it is practical to do so in river basin planning.

How can planning best be coordinated under existing legislative authorities?

The Flood Control Acts authorize the Corps of Engineers to carry out river basin surveys as directed by Acts of Congress or Public Works Committee resolutions and to recommend for Congressional authorization water resource developments for virtually all purposes. When authorized the Corps installs the improvements as Federal projects.

Section 6 of Public Law 566 authorizes USDA to participate with other Federal, State and local agencies in river basin surveys. Public Law 87-639 authorizes the Corps of Engineers and USDA to make joint surveys and submit joint reports for authorization of river basin programs.

For discussion purposes let us disregard authorities of other Federal agencies or the States and the authorities for administrative approval of small projects. Let us note, however, that the Flood Control Acts impose no upper or lower size limitations in area, capacity of reservoirs, or costs of projects. The Flood Control Acts are basically legislation to provide for planning and constructing Federal public works projects. Except for certain capital costs and operation and maintenance costs associated with local protection projects or purposes providing vendible products or services, the Federal Government, through the Corps of Engineers, constructs, pays for, operates and maintains water resource projects authorized by the Flood Control Acts in the same manner as Federal buildings or military establishments.

In contrast Public Law 566 authorizes Federal services, cost sharing and loans to qualified local organizations to construct, operate and maintain local projects that are mutually agreed to by the local organizations, the State Government, USDA, and approving committees of the Congress. Limitations placed on watershed projects include: Areas not in excess of 250,000 acres, individual reservoirs not in excess of 25,000 acre-feet of total capacity and 5,000 acre-feet for floodwater detention capacity, $5,000,000 for a single loan, restriction on the number of recreational developments per project, requirements for land treatment above reservoirs, and other conditions.

P.L. 566 projects are local projects with Federal help and require generally greater non-Federal sharing of costs than Federally constructed projects of similar nature and size. For this reason, local organizations are not inclined to sponsor projects that would provide significant downstream benefits outside the boundaries of the project. Moreover, local organizations have favored small rather than large watershed projects. The average P.L. 566 project planned to date contains 58,000 acres. That is less than one-fourth the legal limitation of 250,000 acres.

The practical question is: How do we get each segment and area of water management planned and carried out in appropriate harmony, sequence and timing with each other segment? What should be the local, State, and Federal participation in each part of the total job? What should be classed as Federal projects and what as non-Federal projects?

The answer at each end of the scale is easy. Land treatment and management are responsibilities of the private landowners' and the public land managing agencies. While major multiple purpose water projects, certainly those on interstate or navigable streams, must generally be the Federal Government's responsibility. In between there is a range of alternatives. But these alternatives should seek the development of the optimum river basin plan. Any division of program responsibility made on the basis of proportion of dispersed or readily identifiable benefits, or because of location within or outside of a watershed area of a specified size, will result in some reservoirs of comparable size in the intermediate categories being Federal projects and some non-Federal projects.

Let us draw the issue more precisely. Under current flood control authority, reservoirs of all sizes are treated alike with respect to cost sharing. This cost sharing differs from P.L. 566. Thus the optimum plan, predicated on cost-sharing formulas of existing law and policy with a division of construction responsibility based on location of benefits, could result in a 2,500 acre-foot Federal reservoir in one small valley and a 2,500 acre-foot local project reservoir in the next valley. If these reservoirs were solely for flood damage prevention, the Federal Government would condemn and buy the land for one, construct it and operate and maintain it. The other equal-size reservoir would require local acquisition of land, easements and rights-of-way, local construction with full Federal reimbursement of construction costs, and local operation and maintenance thereafter without Federal cost.

Such inconsistencies in public policy produce areas of conflict not between Federal agencies but between segments of the public. As the Federal agencies expand cooperative efforts to plan for optimum development in river basins, the urgency increases for finding workable answers to these major inconsistencies in legislative authority. We believe a workable solution under existing laws can be found by making the division between Federal and non-Federal projects on a reservoir capacity and watershed area basis. The dividing line could be established at 25,000 acre-feet of total capacity. Reservoirs above this limit as well as channel and levee improvements on streams draining more than 250,000 acres would be Federal projects. Works within watersheds of 250,000 acres or less would be planned and installed as non-Federal projects as would all reservoirs containing less than 25,000 acre feet.

In closing let me say that we Agriculture Department representatives recognize that the President's assignment to prepare comprehensive plans for all major river basins by 1970 is a real challenge. I have only mentioned a few of the problems which we know are involved in that assignment. Some of those problems have been with us for many years and still the ultimate solutions are not imminent. Yet we are approaching our river basin planning assignment with interest and enthusiasm. I want to assure you that I believe we have accomplished a lot through our cooperative efforts in the past and that the Department's continued help and cooperation can be depended upon in the solution of future problems of mutual interest. I would like to compliment the Corps of Engineers for the highly competent and professional approach to all problems for which we have mutually sought solutions. We in the Soil Conservation Service offer you our best efforts to continue this kind of cooperation.

COMPREHENSIVE PLANNING FOR WATER QUALITY MANAGEMENT

by

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Why is there a Need for Water Quality Management?

During the past 50 years we have witnessed a very dramatic growth in our population in the number of cities, in the number of industries, and in the number of varieties of industries. In 1900 the population of this country was about 75 million. Of this number 39 percent lived in urban areas. The water usage was approximately 35 gallons per capita per day for those residing in the urban areas. Today about 70 percent of our 186 million people reside in urban areas and these use on an average of 150 gallons of water per person per day.

In 1900 there were about 950 communities in the United States with sewer systems. These served approximately 25 million persons. Today there are roughly 12,000 communities having sewer systems. The increase in number of industries has been even more phenomenal. This growth has inevitably placed the outfall of the sewer system closer and closer to the intake of the industry or municipality and the increase in volume of water used and returned to the stream has been multiplied many times.

We have made rather great strides in improving our waste removal and treatment facilities in terms of numbers but have been less successful in improving our capability in removing all types of pollutants. We have come to a point in time where we can see that if we adhere to past concepts of permitting hit-and-miss development of waste treatment and other measures of pollution control, the result will be disastrous. A number of crises have developed during the past 10 years which show us that we are definitely in a critical period and that we no longer can afford to proceed with pollution abatement without a carefully thought out plan and program. We also know that such a guide must be comprehensive, that it must have as its objective the production of water in quality and quantity which will not limit economic and social development. In other words it must be good enough in quality and quantity to sustain and attract continued and new uses, to permit economic expansion and provide for adequate public health protection.

We believe that the tools and the capabilities for developing such a blueprint or guide are now available and that a very useful plan is now possible which can be implemented and operated to achieve the goals which I have just cited.

Authority

The Federal Water Pollution Control Act, Section 2, provides that the Secretary of the Department of Health, Education and Welfare prepare comprehensive programs in cooperation with State, interstate, and other Federal agencies for the purpose of controlling or abating water pollution in surface waters and ground waters of the Nation for all legitimate purposes. The Senate Select Committee and the National Water Pollution Control Conference both concurred in the idea that the development of such comprehensive programs was imperative. The Federal Water Pollution Control Act does not require that individual projects be authorized by Congress. Program development is based solely upon our ability to justify and obtain funds for support.

The Approach to Comprehensive Water Quality Management

We believe that water quality management can only be successfully achieved if it is viewed as a river basin or watershed problem. We do not believe that a plan can be evolved from a group of disconnected individual or subregional programs whether they be by city, industry, or State. We further believe that quantity and quality of water are inseparable and that both are controllable factors which will permit the multiplication of uses indifinitely if properly managed. We believe that quality control can be exerted most efficiently by removing as much of the pollutant as is practical as near the source as possible. In other words, if it is possible to either prevent the pollutant from entering the sewer system or prevent the pollutant from entering the stream, this is the point where major emphasis should be applied in any pollution control program.

We are aware that it is neither practical nor feasible to change engineering practices which have developed great water-carried sewer systems in cities, towns, and metropolitan areas. However, this does not prevent us from advocating as much source control as it is possible to obtain. We are also aware of the technical limitations which prevent us from removing pollution from water. We are aware that treatment and removal capabilities are simply not enough to provide the kind of water quality needed by the many kinds of users existing today without consideration of the potential needs of the future We are, therefore, seeking additional measures to supplement waste treatment or removal which will give us a degree of added protection and increase the usefulness of our waterways.

We view stream regulation as a practical measure which can be applied as a secondary line of defense against the inroads of pollution from treated residual wastes and those wastes not susceptible to treatment or removal. This gives us a two-element system, one supplementing the other, for managing water quality. Each of the two elements of the system can provide certain protection not afforded by the other. In order that they may function in proper relation to each other, it will be necessary to develop a monitoring system which provides operating intelligence. The two elements must be constantly adjusted and balanced according to the kind of water quality desired at specific points in the river basin.

The achievement of a water quality management program will permit all uses of water to be sustained. We also believe that such a water quality management program is part and parcel of the total water resource development program and that it is compatible with National policy to develop the Nation's waterways for recreation, navigation, power, flood control, irrigation, municipal and industrial water supply, and fisheries. We believe, however, that it will be necessary to balance these functions carefully to lessen potential conflicts between uses and that this can only be done through the coordinated planning process.

In organizing for the preparation of the Public Health Service comprehensive water quality management programs, we have concluded that, for the sake of economy and accountability, both in terms of work accomplishments and fiscal matters, the project type organization is superior to others. Therefore, for each basin, we are establishing a special group whose sole function will be to undertake the necessary investigations described. We have divided the Nation into 21 major basins or areas which correspond closely to those areas depicted on the U. S. water resources development map compiled and printed by the Geographical Survey, Department of the Interior, with exceptions as noted. Each area will have a project team consisting of a project director together with an administrative staff capable of a high degree of selfsustenance in budgeting, purchasing, and personnel matters, a laboratory section, an engineering section, a data-processing storage and evaluation section, and a planning and reports section. Each project will be administratively attached to one of our nine regional offices located in Boston, New York, Charlottesville, Virginia; Atlanta, Georgia; Chicago, Illinois; New York City; Dallas, Texas; Denver, Colorado; and San Francisco, California. Top-level consultation on technical problems will be provided from our Cincinnati Robert A. Taft Sanitary Engineering Center staff and general supervision, budget, and policy guidance is provided through the Technical Services Branch in Washington. The Technical Services Branch also will be directly responsible for the review and final approval of reports and plans emanating from the projects. At the present time, projects are under way in the Ark-Red Basins; in the Colorado River Basin; the Columbia River Basin; the Great Lakes-Illinois River Basin; the Delaware River Estuary; the Susquehanna-Chesapeake Bay; and in the Upper Ohio. Approximately 330 people are now engaged in these operations, supported by a $4.5 million appropriation for FY 1963. Project personnel have diverse professional competencies and include chemists, biologists, bacteriologists, engineers, data analysts, and computer programmers, planners, economists, and demographers, physicists and others.

The comprehensive plan is the result of a number of fundamental steps. Our approach may be pictured as the convergence of two vectors. Vector "a" includes the investigations leading to a summary of information concerning the physical, chemical, and biological characteristics of the streams, lakes, and subsurface aquifers which have an effective role in a natural watershed.

We term this summarization a resume of waterways dynamics. This summary is a compilation of the waterway idiosyncracies which give that body personality, including a description of its behavior. For example,-- its volume in terms of frequency distribution, its response to pollution stimuli, its velocity of flow, its natural chemistry, its biology, and microbiology. It includes the amounts of water withdrawn, and the characteristics and amounts of used water returned. It includes all portions of the basin system receiving pollutants or likely to receive pollutants. This information can be expressed by a series of numerical values, ranges, statistical frequencies, probabilities, and locations. These values are representative of observations made in great varieties of frequency and location, gathered over a long enough period to make them statistically valid and broad enough in coverage to assure that no major environmental influences are left out. This is one of the fundamental aspects of the planning phase.

The second major vector is the summarization of the resource economic and physical elements which can be recognized as having an influence on the future development of the area served by the waterway. This summary includes the economic resources, financial and other growth characteristics and opportunities. This summary is again represented by a series of values, rates, frequencies, probabilities, and locations which give dimension to this vector which we call the forecast dimension. It must include many assumptions, such as the expected and planned rates of expansion by area utilities such as the gas, electric, water, and telephone; by the financial interests, the banks, the Federal Reserve System, business and industry, forecasting interests, industrial management and urban planning experts.

These two elements form the basis then for preparing for the plan. Another most important element must also be brought into the picture at this point. An answer must be supplied to the question "what are the water quality goals to be achieved"? The answer must be provided in terms of specific values and qualified as to time, place, and purpose. The Public Health Service, realizing that such goals are not uniform and may vary widely from river to river, is attempting to rationalize these goals by seeking user groups' opinions on the kind of water which should be supplied at given places in the stream system. User groups are brought together first as separate committees. Assistance is provided these groups in defining their job and in providing information on the effects of various kinds of pollutants on present and prospective water use. This concept is now undergoing test in the Chicago area and Illinois River Basin. It appears to be working satisfactorily. Out of the thousands of possible use-quality parameters 12 to 15 may be selected as indicators around which the plan can be developed. Once the water quality goals have been established, it is the planner's responsibility to take the water dynamics information, the forecast information, and to set up and simulate a system which would provide the quality desired using source control and such additional control as may be available in stream flow. He must then decide which of several possible alternatives would give the greatest efficiency and economy.

This you will recognize as amenable to systems analysis techniques. These techniques will be employed extensively in our projects. We intend to carry the planning far enough to illustrate the quality of water which can be discharged, where sewer outfalls should be located to minimize pollution effects on downstream water uses, and what stream flow regulations will be required.

The final report will contain:

(1) estimates of quantity, location, and time that water uses will be incurred; (2) estimates of quantity, quality, location, and time when waste waters will be returned to the streams; (3) summary of waste removal and treatment required in a time sequence to meet the water quality needs for water uses; (4) a summary of water quality goals for the enumerated water uses in terms of values and ranges for specific locations; (5) flow regulation required to supplement waste treatment removal facilities, estimated by volume and location and in terms of chronological developments; (6) a mathematical simulation of factors relating to water use, waste water hydrology, chemical and biological responses in the stream; (7) maps, charts, tables, and graphs depicting the orderly development of counter-measures needed to establish a predetermined quality of water at a given location on or after a certain date insofar as that date is associated with a given population, industrial expansion, and other social and economic factors.

Cooperation and Coordination

The need for cooperation and coordination is evident. We do not intentionally duplicate any work which has been done in accordance with generally-accepted practice and is considered to be statistically valid. The States and other Federal agencies usually have data on waste water flows and their quality characteristics. Hydrological data and similar information is available from several sources among the Federal agencies. These data will be used to the extent applicable. Additional data will be sought to fill gaps either in specific areas or to increase the statistical reliability. Since hydrologic data is important to several agencies, coordination in obtaining these data will be very important.

In our past experience we have found it necessary to do very intensive study of low flow hydrology at a great number of points in a stream system. In an effort to satisfy our needs these studies are usually no longer than two years which, of course, most of us recognize as being generally borderline but the maximum which can be scheduled and financed. We are always hopeful that other interested groups will be in a position to maintain these measurement stations once our particular needs have been met.

Background economic studies and demographic projections are likewise important to several water resource development agencies. We believe that joint undertaking of these studies is highly desirable and is a practical approach to securing and financing them. It is our policy to seek those studies and data from agencies qualified to provide them, subsidizing such studies as necessary. It is

important for example, that we have the best estimates of the size and location of water-oriented recreational parks. The Bureau of Outdoor Recreation is in the best position to provide such information, and requests for such reports are addressed to them. We also have engaged private engineering consulting firms to study certain problems for us. This includes such investigations as storm water overflows from city and metropolitan areas. These kinds of studies are amenable to contract investigations. We are, of course, interested in coordination of budgets which, in turn, leads to coordinated planning. This boils down to really knowing and appreciating what the other chap is trying to do and the problems he faces in accomplishing his tasks. Budget coordination is beset by many obstacles with which the group is as familiar as I am. I am hopeful that, given time and patience and understanding, it will be possible to move forward with water resource development in a planned manner so that crises which we feel are imminent need not occur.

To plan for the preservation and protection of the Nation's water resources is essential if we are going to develop them in an economical, efficient fashion and avoid costly crash programs, conflicts between water use interests, and above all provide enough good quality water to insure continued good health and economic opportunities.

NOTES ON TRANSPORTATION POLICY

by
Byron Nupp
Office of the Under Secretary
for Transportation
Department of Commerce

Background of Transportation Responsibility of Department of Commerce

The Organic Act of the Department dated February 14, 1903 provides that the Department shall "...foster, promote, and develop the foreign and domestic commerce, the manufacturing and shipping industries, and the transportation facilities of the United States."

In 1949 the Hoover Commission recommended, after an intensive task force study by Charles L. Dearing and Wilfred Owen, that the Department of Commerce intensify its transportation work in two ways; first, through the transfer of several large transportation programs to the Department, and second, through the assumption of leadership in dealing with transportation policy generally. Dearing and Owen had recommended that this two-fold function be handled through the creation of a Department of Transportation. Under Reorganization Plan 21 of 1950 the essential recommendations of the Hoover Commission were carried out through the Department of Commerce. The Office of Under Secretary for Transportation was created to carry out the leadership function in matters of transportation policy.

Scope of Transportation Interest

At some time or other in its history, the Department of Commerce has administered or has made important contributions to practically every form of transportation and Federal transportation program. The Department starting in 1926 pioneered the systematic development of the Federal airways systems, and continued to administer the main aviation programs until the Federal Aviation Act of 1958. In inland waterways, the Department in the 1920's and until 1936 prepared the economic evaluation studies for major inland waterway projects. In 1939 the Inland Waterways Corporation and its Federal Barge Line were transferred to the Department and remained until the line was sold to private enterprise in 1953. In 1958 the administration of the St. Lawrence Seaway was transferred by Executive Order to the Department of Commerce. Earlier, in 1941 the Department developed the definitive study of the Seaway under the direction of N.R. Danielian. In 1949 and 1950 the Federal-aid highway programs administered by the Bureau of Public Roads, and the merchant marine program were transferred to the Department. In 1962 the Aviation Loan Guarantee Program was transferred and the President has recommended the transfer of the

same program for railroads from the ICC to Commerce. The President has also recommended that the Department conduct a survey of rapid surface transportation in the Northeast Metropolitan Corridor from Washington to Boston, as well as develop a basic scientific research program in transportation. We have been involved in efforts to solve the New Haven Railroad problem; in 1962 we sponsored a special reconnaissance team to survey the property to assess its possibilities for survival. At the request of the President we assist the Justice Department in dealing with mergers, and our interagency group on transport mergers has issued a public statement of acceptable merger criteria to guide the industry.

In the field of general policy the Department has taken the lead in efforts to modernize the Interstate Commerce Act. In 1955 the Weeks Report was issued under the leadership of the Department, and this started the chain of events that resulted in the basic legislative changes in the Transportation Act of 1958. On April 5, 1962 the President sent to Congress a fundamental Message on Transportation which called for further modernization of transport regulation, a consistent pattern of user charges for highways, airways, and waterways, a program for urban transportation, and a better effort in transportation research. The Department has taken the lead in efforts to secure legislation to implement the President's Message. The Department has also undertaken cooperative efforts with the Housing and Home Finance Agency to improve conditions of transportation in metropolitan areas, through better planning and a wider choice of transport modes and services. In 1961 the two agencies jointly studied the urban transit problem and evolved a program which has been endorsed by the Administration.

Phases of the Transportation Problem

Federal interest in Transportation has three phases; regulatory, promotional, and the impact on transportation of general government policies of defense, procurement, taxation, labor, and so forth.

In the field of regulation the Department has worked consistently within each Administration to develop the President's program for regulatory policy.

Promotion means direct efforts to aid transportation, such as the provision of highways, airways and airports, and waterways, or the subsidization of transportation to promote public objectives. Promotional efforts reside not only in the Department of Commerce, but in the Corps of Engineers, the Federal Aviation Agency, the Housing and Home Finance Agency, as well as the activities of the regulatory commissions and other bodies.

In the field of general policy and transportation, the Department since 1961 has administered a program to plan for mobilization of the transportation facilities of the Nation in time of emergency. An Office of Emergency Transportation has been created. We have interested

ourselves in the matter of how the welfare of transportation is affected by special rates for government services. We believe as a rule that transportation should be affected by public policies in a manner consistent with the impact of government on industry or the economy generally. This is necessary because transportation is a prime function in a private profit based economy.

Inter-Departmental Coordination a Basic Tool of Transport Policy Formation

Perhaps the Hoover Commission over-emphasized the importance of centralized management of transportation programs, although the need for coordinated transportation policies is still great. Our experience has demonstrated the vast amount of public and private interest and divergency of viewpoint exposed in any transportation problem in addition to the great variety of interest and viewpoint o general policy issues.

For this reason, we have always worked with other agencies, either by choice or necessity. The Weeks Report, for instance, was prepared by a Cabinet Committee consisting of the Secretary of Commerce as Chairman, the Secretary of Defense, and the Director of the Office of Defense Mobilization, with the added participation of Treasury and Agriculture. Urban transportation work relies on the close cooperation of the Department of Commerce and the Housing and Home Finance Agency.

Federal Policy in the area of water transportation must be related to matters of National defense, and other Federal development policies such as power, recreation, and conservation. There is a long history of inter-agency coordination in the water resources field. Even such a detailed matter as standards for bridge clearances on navigable waterways involves both the water transport agencies and the land transport agencies in a cooperative effort to determine policy.

Government administrators should give conscious effort and thought to improving the processes of inter-agency coordination. Cabinet Committees, joint agreements, staff details, and other mechanisms are well known. Other tools might include systematic delegation provisions in organic laws, policy and procedure manuals which provide for coordination with other programs and levels of consultation required, and guidance by setting up common standards, particularly in area planning, benefitting from the experience gained to date.

Long Range Planning Approach to Transportation Policy

Our transportation policy work lacks sufficient development in long range forecasting. We require not only long range data on the overall needs for transportation but also knowledge on how the

division of traffic among modes is accomplished over long run periods. We are now experimenting with advanced techniques which might offer some clues on overall long run transportation needs and the modal division, both for the Nation and for some of the large regional areas of the country. When the Census of Transportation is completed, new data will give us better insights into such problems. From the technical standpoint we seek to understand how growth in transportation output as a whole and in each mode is differentially related to general influences such as population and economic growth, and how it is related to intermodal factors and trends.

We also need to know more about how the stock of investment in publicly and privately owned transportation facilities relates over long periods to the output of transportation. Interesting studies of this relationship have been made for industry generally, for railroads, and for public utilities by the National Bureau of Economic Research. Such trend relationships may have definite application to the programming of public investment programs.

Regional Planning as an Approach to Transportation Policy

In the Corps of Engineers the experience with the historic "308" program has demonstrated the need to relate resources development to comprehensive regional plans. Multiple-purpose river basin planning is a well established institution which has a bearing on transportation practice and which assists policy-making based on broad understanding of regional needs. It provides not only a basis for judgment of what new facilities might be constructed, but through its impact on general economic development provides a means of measuring transportation need by all modes in the region.

Our Departmental agencies have made very good progress in the field of Federal promotion and assistance to metropolitan area planning. We have found that there are functional relationships which can be established between static land uses and the movement of persons and goods. This interaction is the basis of modern metropolitan area planning, using vast stores of data, sophisticated mathematical techniques, and data processing. Such planning can be accomplished on a continuing basis. For example in the Federal Aid Highway Act of 1962 there is a requirement that beginning in 1965 Federal highway expenditures in urban areas must be made in accordance with continuing planning processes. Transit aid and urban renewal programs are also predicated on planning processes. The Area Redevelopment Act also provides for an area planning approach to program expenditures.

Various Federal aids are offered to assist State and local governments comply with these new laws. The greatest effort in monetary terms has been through the Federal-aid highway program which permits 1½ percent of all Federal aid funds authorized to be used for planning. Studies in many great metropolitan areas often

costing millions of dollars, have been placed under way with this program. There is also the general Federal aid to metropolitan area planning provided in Section 701 of the Housing Act of 1954. The Department of Commerce has concluded an agreement with the Housing and Home Finance Agency to authorize the joint use of highway planning funds and Section 701 funds in broad metropolitan area studies. Already 22 areas have initiated such joint planning programs, with some 35 making plans to do so.

Very likely all Federal expenditures will sooner or later be required to conform to approved regional plans, either of the resource type or the metropolitan area type. The melding and coordination of the various Federal aids to regional planning is an increasing operational necessity bringing with it numerous problems. Interagency coordination will be severely tested. A central planning staff, or the Budget Bureau, may be called upon to provide common standards for such plans, to keep such plans on record and up to date, and to review agency programs for conformity. In view of this agencies such as the Corps of Engineers and the Department of Commerce will certainly continue to have important responsibilities in working out such plans and in developing new planning concepts.

ROLE OF AREA REDEVELOPMENT ADMINISTRATION

IN RIVER BASIN PLANNING

By Victor Roterus, Economic Advisor to the Administrator,
Area Redevelopment Administration, U. S. Department of Commerce

Since the Area Redevelopment Act (Public Law 87-27) was passed as recently as May 1, 1961, it may be helpful to review the background and objectives of this Act and initial progress under it before discussing the relationship of this program to river basin planning.

Program of the Area Redevelopment Administration.

Some of the effects of a growing, dynamic economy fall adversely and with dislocating impact on certain local areas. These are particularly areas whose economy has been built on a single industry, a single crop, or a single resource. A change in market demand from coal to oil or gas in domestic heating, a change in the conditions under which an industry finds superior production-marketing advantages in another geographic location, technological improvements which permit greater production with less employees--all these have at least a temporary disruption on certain areas. When those who are forced into idleness are unable to shift readily into new occupations or to move their residences to areas where greater employment opportunities may exist, the problem of adjustment becomes long and costly--costly not only to the individuals and their families but to the nation as well.

The Area Redevelopment Administration of the Department of Commerce was set up by the Congress in May, 1961, to help accelerate the adjustment of these victim areas of change so that they could be making their rightful contribution to national growth and prosperity. There are 1,057 such areas of unemployment or underemployment concentration in the United States today.

In general, the areas that have been designated under the Act are of two general kinds: (1) urban-industrial areas characterized by substantial unemployment of a chronic, rather than temporal, kind--these are the areas which have suffered severe economic dislocation at one time, and (2) rural areas marked by substantial underemployment as measured by abnormally low incomes. The urban-industrial areas characteristically include certain textile towns of New England--such as Lowell, Fall River, and Saco-Biddeford--the Pennsylvania anthracite area cities such as Scranton and Wilkes-Barre, the Appalachian coal

towns from Uniontown, Pennsylvania, to Jasper, Alabama, the coal areas of Southern Illinois and Indiana, and the iron and copper towns and cut-over areas of the Upper Lakes States. The more rural areas of low income are generally found in southeastern United States and in the Indian reservations of the West. The problem here may be that the people are working inadequate resources (e.g., small farms with poor soil and slope conditions), that they are inadequately trained for the available productive occupations, or that they simply lack opportunities for profitable employment. As a result, their standard of living is low, and they contribute neither to their own prosperity or that of the nation.

One-sixth (34.3 million) of the total population of the United States lives in these areas. One-sixth of the nation's labor force can be found in these areas. But almost one-third of the Nation's jobless (1.4 million) is concentrated in these areas, not to mention the underemployed. If the employment rates in these areas approximated more desirable levels, the added production to the nation's gross national product would be between $6 and $7 billions annually--truly a candle worth the lighting. Besides the substantial contributions these areas can potentially make to national growth, it should be remembered that expenditures and investments made in these areas are relatively inflation-free in their effects since we are dealing mainly with excess in manpower and facilities.

Let me review briefly the tools we are using and some of the results we are getting in our redevelopment program.

(1) Local communities have been stimulated to work in a more systemmatic way toward solution of their economic problems. Some 850 redevelopment areas have official redevelopment committees, consisting of representation from business, labor, agriculture, education, local government, and other groups. These committees have gotten together, examined their problems, identified the resources which might be used to stimulate new business and industries, and formulated a plan of action called an overall economic development program. Of 1,057 designated areas, 845 have submitted such programs which are not only guiding their own efforts but state and Federal assistance as well. It is noteworthy that these local programs encompass a range of subject matter and action items far beyond the direct responsibilities of ARA. Illustrative of the progress of some of these communities is the attached letter from the Redevelopment Committee in Mountain City, Tennessee. (pages 141 and 142)

(2) A second tool by means of which ARA assists these areas is loans for developing new business and industry in these areas. Entrepreneurs in these areas now have available capital to help carry

out their ideas for new businesses and for creating new jobs. Capital is now also available to supplement local and private funds in financing branch plant expansions in these areas. As of May 6 of this year, 173 industrial loans amounting to $59 millions had been made. The recipients of the loans estimated that their enterprises would employ some 18,700 workers directly when their enterprises became fully operable. The employment and payrolls associated with these enterprises will, of course, stimulate further employment in the service activities of these areas. The volume of the industrial loan activity, rather slow in the initial period of administration of the Act, is steadily increasing.

(3) A third tool of ARA is loans and grants for public facilities. These are made when the areas can show that the facility--such as water supply, sewerage, or an access road to an industrial site--is required to service the needs of an expanding industry or commercial enterprise. As of May 6, $48 millions had been advanced for 96 public facility projects. Estimates accompanying the project applications have indicated that these facilities are required to support an expansion of private industrial employment estimated at over 20,000 direct jobs.

Many redevelopment communities need certain public facilities before they can ever hope to begin to meet the requirements of a new private industrial or commercial enterprise. The Accelerated Public Works Act--a temporary companion piece of legislation to the Area Redevelopment Administration--is providing badly needed jobs immediately, but, in addition, the $900 million authorized under this Act is helping redevelopment areas and other communities with substantial unemployment to get their house in order so that private job-creating investments will be attracted.

(4) Another tool that was provided ARA in order to help the chronic unemployment and underemployment areas make an appropriate contribution to national growth, was an annual appropriation not to exceed $4.5 million for technical assistance. This money have been largely used to break the bottlenecks to economic development as identified by local redevelopment areas in their programs. For example, an area in Southern Ohio is now armed with the facts about the quality and extent of its salt brine resources so that several industries are actively studying possible locations in that area.

(5) A final help to redevelopment areas in the ARA program is the job retraining provisions which are administered by the Secretary of Labor and the Secretary of Health, Education and Welfare. As of May 6, some 19,000 worker-trainees taking part in 370 projects were involved in the program. Of those completing training, about two-thirds have been placed on training-related jobs, and these are jobs in areas whose unemployment rates have been substantially higher than the national rate.

s a brief summary of the major elements of the Area Redevelopment Administration's program which, in a sense, is still in its swaddling clothes. Now what is the relation of this program to river basin planning and why should anyone concerned with the latter activity be interested in ARA?

There are a number of points at which your program (in fact, all resource development programs) and our program come together in a real way--both philosophically and operationally. There are at least four significant points of mutual concern. Let me identify and briefly discuss these.

(1) I shall mention the most obvious point of mutuality first. That is, our geographical areas of interest are so many and so distributed that all major river basins have at least several officially designated redevelopment areas. Although we designate new areas when they qualify and terminate their redevelopment status when their employment and income conditions improve sufficiently, by and large you can expect the present general pattern of areas to persist for more than several years. My point is simply that all over the nation you and we in ARA often find ourselves working on the same geographical areas, even though the coincidence between our respective areas is seldom perfect or complete.

(2) However, the affinity between our programs goes far beyond a common real estate interest. Fundamentally, our ultimate objectives are the same or are at least in the same tandem. The converse side of unemployment is employment. Employment is production and this is the essence of economic growth. Similarly as the rains and water are harnessed to purposes useful to man, these resources contribute to the creation of energy, facilitation of commerce and recreation, the location of industries--all of which are necessary if our economy is to grow and to produce more abundantly.

In the context of economic growth, an attack on the areas of concentrated unemployment makes particular sense for three reasons:

(a) The contribution to gross national product can be increased $6 - $7 billion annually if the unemployment rate in redevelopment areas can be reduced to an average of 4 percent,

(b) Expenditures and investments in redevelopment areas have a relatively non-inflationary impact since we are dealing with excesses in manpower and generally in facilities,

(c) With the notable shift over from production jobs to service jobs that has been a characteristic trend of our economy over recent years, we perhaps must expect a slow down in our productivity growth from this change in our industrial mix since the services are generally less prone to equipment, machine and other means for increasing worker productivity. This means that we must cultivate to the full our other possible avenues to greater economic growth, and this includes more concentration on the fuller use of the unemployed and of our natural resources.

(3) A third point of kinship in our programs is not only with respect to our philosophical objectives but with respect to our operational activities in attempting to realize these objectives.

Let me explain. You are in the business of developing resources. We are in the business of creating jobs through making loans for new or expanding commercial and industrial enterprises. However, a business enterprise demands more than land or space in a particular environment before it will locate a new enterprise there. The various elements that will successfully support an enterprise must be present--such as transportation and other supporting services and certain input or output elements (usually in combination) that will give the enterprise some competitive edge.

These elements too often may be present for potential use, but are not in reality available until some development work has taken place. For example, one of the potentialities of the rather depressed Appalachian area is with respect to that fast growing industry, tourism. Mountain scenery, relatively cool nights, historical interests, and other factors contributed to this potentiality. However, the area lacks bodies of water for boating, swimming, and to provide the focus for tourist development. This in spite of the fact that the rainfall and topography for creation of lakes is propitious.

Water developments here on a multiple use basis, but with a special consideration for providing the base for growth of the tourist industry, would provide the spark for substantial private investments and lead to the creation of many jobs. In other words, a program of river basin resource development must necessarily precede private investment. Our redevelopment tools of financial assistance to enterprises and facilities are most effective when teamed with a broad program of river basin and resource development.

(4) This leads me to my final point of the relation of ARA to river basin planning. It seems that new economic growth is more and more related to what have come to be termed as package deals. The

very scale and complexity of certain ventures, and the public powers and finances required to achieve them, call for private, state and Federal collaboration in such things as urban renewal, integrated community ventures, and of course river basin development. The brief experience of ARA with the breaking of technical bottlenecks to economic development and in extending public facility assistance to make possible follow-up investments in industrial and commercial enterprises indicates a great potentiality for purposeful teamwork in regional (and national) economic growth.

This is a subject area in which it would appear that there are great possibilities. We sense that imagination and teamwork among agencies, among government levels, and with private enterprisers can do much to contribute to national growth and prosperity. The challenge is for each group to use its tools in concert to speed up and make possible greater attainment of the objectives with which we are charged. ARA with its particular tool kit and the resource agencies with theirs offer real possibilities for meaningful cooperation in river basin planning. We are not at this time prepared to suggest how this cooperation should proceed and what its mechanics might be. Our early preoccupation has been with getting those activities more explicitly outlined in our legislation underway. However, we have the makings for useful collaboration in our local redevelopment committees with their overall economic development programs, in our force of field coordinators, and in our collaborators in the state and Federal governments. Hence I appreciate the invitation and opportunity to discuss this with you at greater length.

A. N. BLEVINS
CHAIRMAN
MCQUOWN WRIGHT,
SECRETARY
R. J. HOWARD,
TREASURER
TELEPHONE 4821

JOHNSON COUNTY INDUSTRIAL
COMMISSION, INC.
130 EAST MAIN STREET
MOUNTAIN CITY, TENN.

October 26, 1962

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Mr. T. K. Pasma, Chief
Area Plans Division
Office of Planning and Research
U. S. Department of Commerce
Area Redevelopment Administration
Washington 25, D. C.

Dear Mr. Pasma:

We appreciate your granting us the 60-day extension of the due date for our Overall Economic Development Program (OEDP). We are more than glad to give you a brief report on our progress.

Progress in Johnson County has been very good this past year. Many of the things we planned to do in our provisional OEDP have completed. To summarize, the following accomplishments have been made.

1. Received a loan of $60,000 and a grant of $46,300 through the Area Redevelopment Administration to provide water and sewerage for the $400,000 industrial building.

2. Completed the 30 acre industrial park with the exception of the access highway. Developed plant sites are now available for 1000 to 1200 job opportunities; efforts are now being made to obtain these jobs.

3. The Leco Company moved into the industrial building. They are now working about 220 people with an annual payroll of more than $550,000, some 100 additional employees are expected to be added within the year.

4. A pilot glove plant started operations in the local tobacco warehouse, with about 100 workers. Plans call for a 30,000 square foot building with 200 workers and an annual payroll of abouh $500,000.

5. A small machine shop has requested financial assistance from ARA for expansion. Plans are to work about 25 people.

6. Plans are being made to establish a local pottery company which will work about 50 people; ARA assistance has been requested.

7. The town of Mountain City is making plans to request assistance through the Public Works Bill for a sewerage system.

8. The county is making plans for the construction of a new modern high school.

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The Area Redevelopment Program served as a catalyst in bringing about these developments. It provided the incentive for the people to come together as a coordinated group and look at the present situation, discuss the problems and make plans for action.

The writing of this comprehensive has been a cooperative effort of many local people and cooperation of many State and Federal Agencies.

In April, 1962 a request was sent by the Industrial Commission asking for people to assist in an economic development program for the county. As a result about 250 people signed that they would be willing to assist in such a program.

These people were then divided into sixteen committees with a chairman for each committee. A mass meeting was held on May 26 at which time the program was explained in detail. A short time later each committee met with a representative of the University of Tennessee Agrucultural Extension Service, who explained the procedure to be followed and the information needed.

Each committee then collected the needed information and made an analysis. Then each committee chairman brought the material together and coordinated it into one program.

On September 21 a rough draft of our comprehensive OEDP was used as an example in a State Workshop. The purpose of this workshop was to learn what should be included in a good Comprehensive OEDP. Various State and Federal Agencies helped to review our OEDP in light of recommendations made by your office.

The committees have been incorporating into the OEDP the suggestions made at the workshop.

The OEDP has now been written. It is now being further checked and should be ready for the printer in about a week. The printing will probably take 30-45 days. This is due to the fact that it probably will be printed locally by the newspaper. The time spent on this will be done each week after the newspaper is printed.

This should bring you up to date on our progress.

Sinderely,

R. J. Howard

R. J. Howard, Treasurer
Johnson County Industrial Commission

RJH/pg

USCOMM--DC

THE FEDERAL POWER COMMISSION'S INTEREST IN WATER RESOURCES PLANNING ACTIVITIES

by
F. Stewart Brown
Chief, Bureau of Power
Federal Power Commission

Functions of FPC Related to Water Resources

The Federal Power Commission has many important responsibilities in the field of water resources planning. These responsibilities stem from several statutes, beginning with the Federal Water Power Act of 1920 which created the Commission primarily to administer a system of licensing for non-federal hydroelectric power projects. In 1935 the Federal Water Power Act was enlarged into the Federal Power Act, and the Commission's jurisdiction was extended to the interstate transmission of electric energy and its sale at wholesale in interstate commerce. The Flood Control Acts and other statutes, such as the Bonneville Act and Fort Peck Act, have provided additional responsibilities.

Briefly, the Commission performs the following functions relating to water resources: It issues licenses to non-federal interests, public and private, for hydroelectric power development; it makes river basin planning studies and power market surveys; it keeps up-to-date estimates of the water power resources of the country; it participates in inter-agency activities and advises the constructing agencies on power matters; it makes headwater benefits investigations and determines payments to be made on account of such benefits; it allocates the cost of certain Federal multiple-purpose projects; and it approves the rates for power produced at certain Federal hydroelectric projects.

History of FPC

For those who may not be familiar with its history, the Federal Power Commission originally was composed of the Secretaries of War, Interior, and Agriculture. In 1930 the Commission was reorganized as an independent agency with five full-time Commissioners appointed by the President and confirmed by the Senate. In addition to the Federal Power Act, the Commission administers the Natural Gas Act which was enacted in 1938.

Currently, there are approximately 1,000 employees on the staff, and the appropriation for fiscal year 1963 amounts to $10,700,000. Organizationally, the staff is composed of the Executive Director and eleven separate bureaus and offices which are responsible for various phases of the Commission's work. The two principal operating organizational units are the Bureau of Natural Gas and the Bureau of Power.

The Bureau of Power, consisting of four Divisions in the Washington Office and Regional Offices in New York, Atlanta, Chicago, Fort Worth, and San Francisco, is responsible for the engineering phases of the Commission's work in the power field.

Licensing of Hydroelectric Projects

Under its licensing function the Commission issues licenses to individuals, corporations, States, and municipalities authorizing the construction, operation, and maintenance of water power projects on government lands and on streams over which the Congress has jurisdiction. It may also issue licenses to these non-federal interests for the purpose of utilizing the surplus water or water power from a government dam.

A very important conservation requirement of the Federal Power Act is found in Section 10(a), which requires that the project to be licensed "shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water-power development, and for other beneficial public uses, including recreational purposes; and if necessary in order to secure such plan the Commission shall have authority to require the modification of any project and of the plans and specifications of the project works before approval". To be licensed, a project does not necessarily have to include all units of the comprehensive plan, but such units as are included must fit into the plan. In cases where plans equally well adapted are submitted by competing public and private applicants, preference must be given to the public applicant.

An important provision in the licensing process is contained in Section 23(b) of the Act requiring that a "declaration of intention" be filed with the Federal Power Commission for any project proposed for construction on waters other than those defined as navigable and over which Congress has jurisdiction. If upon investigation the Commission should find that the interests of interstate or foreign commerce would be affected by such proposed construction, the project works may not be constructed until a license is obtained from the Commission. If the Commission should find that such interests would not be affected, and if no public lands or reservations are affected, construction may proceed upon compliance with State laws.

Should an entity, other than Federal, wish to develop a water-power site over which Congress has jurisdiction but has not formulated project plans to the extent required for the issuance of a license, an application may be filed under the provisions of Sections 4 and 5 of the Act for a preliminary permit for the purpose of maintaining

priority of application for a license. The maximum period for a preliminary permit is three years. During this time the permittee may make surveys, prepare plans, specifications, and cost estimates, and arrange for the financing of the project. A preliminary permit does not authorize any construction. It is not transferable and may be revoked by the Commission upon failure of the permittee to comply with its conditions.

An applicant for a license must submit to the Commission such plans, specifications, and cost estimates as are required for a full understanding and appraisal of the proposed project, satisfactory evidence of compliance with the laws of the State in which the project is located, and such additional information as may be required. Recently the Commission revised its regulations to require each applicant to file a plan for the public use of project lands and waters for recreational purposes. If the application is not contested a license may be issued in about six months after filing, provided the applicant has furnished all the information required and the project meets the standards set forth in the Federal Power Act. However, in contested cases requiring a hearing additional time is usually required before a license can be issued.

The Commission notifies interested Governors, Federal, State, and local agencies, of applications for preliminary permits and licenses for hydroelectric projects and gives them an opportunity to submit comments. In addition, before acting on an application, the Commission requests the Secretaries of the Army, Agriculture, Interior, and Health, Education and Welfare to comment on the project as it affects their interests, and, if other departments or agencies of the government are involved, they are likewise requested to furnish their views. These actions which I have just enumerated partly account for the six months or more required to process a license application.

Licenses issued under the Federal Power Act are granted for a definite term not in excess of fifty years. This provision gives the licensee an assured period in which to occupy a power site and to enjoy the benefits derived from the development. At the same time, it also preserves and protects the rights of the public in the nation's water-power resources. A license may not be issued by the Commission for projects in national parks or monuments. Furthermore, a license affecting a reservation of the United States may be issued only after the Commission has found that the license will not interfere or be inconsistent with the purpose of the reservation.

Licensees are required to maintain project works in a condition of repair adequate for the efficient operation of such works; they must maintain and operate them, when applicable, so as not to impair navigation; and they must conform to such rules and regulations as the Commission may prescribe for the protection of life, health, and property. Another requirement is the payment of a reasonable annual

fee by the licensee to reimburse the United States for costs of administering the Federal Power Act and for the privilege of occupying and using property of the United States.

In addition to the foregoing standard provisions, licenses usually contain special provisions peculiar to the individual project. Such provisions might be in the interest of flood control, navigation, public health, recreation, the preservation of scenic beauty, or the protection of fish.

Before a license is issued, project plans are given a careful engineering analysis by the Commission's engineering staff. The designs are checked to assure that the structures proposed would be safe and the project features adequate. Occasionally it is necessary to require alterations in design or in the plan of operation. Field supervision to assure compliance with the license conditions both during construction and after the project is in operation is performed by the Commission's Regional Offices or other authorized government agency as specified in the license.

As of January 1, 1963 there were licenses in effect for 272 major projects having some 16 million kilowatts of existing installed capacity and 25 million kilowatts of ultimate capacity. The existing capacity under license represents 73 percent of all non-federal hydroelectric capacity in the United States. The ultimate installations under major licenses involve a claimed or estimated cost of about $5.5 billion.

River Basin Planning Studies

The second principal function of the Commission relating to water resources covers its river basin planning studies. These studies are made by the staff for licensing and other Commission purposes. A primary objective is to contribute to a sound and orderly development of the nation's water resources. Basic authority for such Commission studies is contained in Section 4(a) of the Federal Power Act. That section authorizes and empowers the Commission "to make investigations and to collect and record data concerning the utilization of the water resources of any region to be developed, the water-power industry and its relation to other industries and to interstate or foreign commerce, and concerning the location, capacity, development costs, and relation to market of power sites, and whether the power from government dams can be advantageously used by the United States for its public purposes, and what is a fair value of such power, to the extent the Commission may deem necessary or useful for the purposes of this Act".

Section 4(c) of the Act authorizes the Commission "to cooperate with the executive departments and other agencies of State or National Governments in such investigations; and for such purposes the several

departments and agencies of the National Government are authorized and directed upon the request of the Commission to furnish such records, papers, and information in their possession as may be requested by the Commission, and temporarily to detail to the Commission such officers or experts as may be necessary in such investigations."

As previously noted, before the Commission can issue a license for a hydroelectric project it must make a finding that the project would be best adapted to a comprehensive plan for developing the river basin for power and other beneficial public uses. Unless an adequate basin development plan is available, the Commission cannot act expeditiously in processing a license application. Experience of the Commission during recent years in issuing 190 licenses for major projects has shown that in more than 80 percent of the cases there was, at the time of the application, no basin development plan, or the available plan was inadequate or obsolete. Currently there are about 70 license applications for major hydroelectric projects pending before the Commission. Thus, it is apparent that the Commission has an immediate need for basin development plans in many areas of the country.

Because of its immediate and continuing need for basin development plans, the Commission is undertaking a Water Resources Appraisal Program. First, an initial screening is to be made by summarizing the planning and development status of all of the major river basins of the country in order to determine for each the need for basin plans for licensing and other Commission purposes, and the plans of others for accomplishing such needed planning. It is contemplated that detailed planning or appraisal studies will be made for approximately 25 river basins over a period of about three years. The studies will be made for those basins currently most in need of plans for Commission purposes and for which early investigations are not contemplated by others. Each of the Commission's five Regional Offices now has under way a study of a basin, with the objective of providing samples of the types of reports that can be prepared.

The Commission's program will be designed primarily to supplement the work of others so as to meet specific Commission needs for early studies in particular basins. In making the studies, the fullest possible cooperation will be sought with affected Federal, State, and local agencies and interests. It is anticipated that reports prepared under this program will be published, either for single basins or for groups of related basins.

Cooperative Studies with Federal Agencies

The Commission's broad investigatory authority under the Federal Power Act was supplemented by the Flood Control Act of 1938, and subsequent Flood Control and River and Harbor Acts, with the provision

that penstocks or other similar facilities should be installed in dams therein authorized when approved by the Secretary of the Army upon the recommendation of the Chief of Engineers and the Federal Power Commission.

The principal role of the Commission in the cooperative investigations with the Federal constructing and planning agencies is to furnish advice on electric power matters. This involves estimates of the amount and value of hydroelectric power capable of being developed in connection with proposed plans, estimates of the future market for such power, and recommendations as to provisions for developing the power potential.

The Commission's cooperative studies with other Federal agencies, including the Corps of Engineers and the Bureau of Reclamation, begin early in the investigatory stage. The initial studies, which are made by the Regional Offices in cooperation with the field offices of the other agencies, include the hydraulic and power operation routings necessary to determine the amounts of power available under proposed plans of improvement or under suggested alternative development plans; and estimates of the value, market for, and indicated feasibility of power potentially available. These studies are used in determining the facilities that should be provided in order to develop or safeguard the power potential of project sites.

When reports of survey scope are developed at higher levels of authority in the Federal constructing agencies, they are sent to the Commission for formal comments. We refer these reports to our Regional Offices for review and comments. On the basis of their comments and the general review which is made by our staff in Washington, Commission letters of comments are prepared and sent to the constructing agencies.

Procedures similar to those described above are followed during the preparation of Corps of Engineers' Design Memoranda. Such memoranda are prepared, after congressional authorization of the projects, for purposes of detailed project analysis in the process of readying proposed projects for construction. The Commission's letters on projects at this stage are addressed to the Secretary of the Army and, pursuant to provisions of the Flood Control and River and Harbor Acts, include specific recommendations with respect to the installation of power or the provision of facilities adapted to the possible future development of hydroelectric power.

We are currently looking for a solution to a problem of timing that we have recently encountered in making Commission recommendations with regard to Design Memoranda. In certain cases the memoranda have been received by the Commission at such advanced stages of planning or design that modifications of the projects

would not have been practicable in the event the Commission had decided to make such recommendations. In the current fiscal year the Corps has received construction funds for four major power projects for which the Design Memoranda have not yet been sent to the Commission for comments. We are discussing this matter with the Office of the Chief of Engineers and hope to reach a satisfactory solution to the problem. We have already taken steps to assure a closer review by our Washington staff of the cooperative studies of the Regional Offices.

Water Power Resources

An important result of the Commission's river basin studies, made both in connection with the licensing and other Commission functions and in cooperation with the other Federal agencies, is the nationwide inventory of water power resources. Data on individual developed and undeveloped hydroelectric power projects are compiled annually and published periodically. The estimates of undeveloped water power include projects concerning which economic feasibility has been demonstrated, as well as projects at sites where physical conditions indicate engineering feasibility and promise at some time of economic feasibility. The estimates are, of course, subject to revision by increase or decrease as conditions may change or as additional information becomes available. It is believed, however, that the estimates, in the aggregate, serve to indicate from a long-range view the overall possibilities for water-power development in the United States.

As of January 1, 1963, the estimates of total hydroelectric resources of the United States amount to 150 million kilowatts of conventional generating capacity, capable of producing 640 billion kilowatt-hours of electric energy annually with average flows in rivers and streams. This capacity includes a potential of some 20 million kilowatts in Alaska. About 38 million kilowatts of capacity are in existing hydroelectric developments, generating an average of nearly 200 billion kilowatt-hours annually.

Ownership of the existing hydroelectric capacity is as follows: Federal, 16.1 million kilowatts; non-federal publicly owned utilities, 7.6 million kilowatts; privately owned utilities, 13.7 million kilowatts; and industrially owned, 0.7 million kilowatts. Of the Federal capacity, 7.9 million is in Corps of Engineers projects; 5.3 million is in Bureau of Reclamation projects and 2.9 million is in TVA projects.

In general, the Commission's listing of undeveloped hydroelectric power does not include future pumped storage developments. Such projects must, of necessity, be designed specifically to meet

site conditions, as well as particular system load requirements. In theory, of course, the number of sites available for pumped storage use is virtually unlimited. We have tabulated sites having received at least preliminary consideration, which could provide capacity aggregating nearly 35 million kilowatts.

Power Market Surveys

Power market surveys are usually made to determine the market for power from an electric generating plant or group of plants. Over the years the Commission has made power market surveys covering essentially the entire United States. Some of the surveys have been initiated as a part of the Commission's river basin planning studies and licensing activities. Others have been made at the specific request of other Federal agencies or States, or in connection with investigations conducted by inter-agency committees or international committees. In most cases they have been made in connection with proposed hydroelectric power developments.

Power market surveys may vary considerably in scope depending upon individual needs. Each survey involves determining the extent of the area in which power from the project or group of projects can logically be marketed, and estimating future growth of the area's power requirements for as long a period in the future as may be necessary to evaluate the project. The survey also may involve determining the need for additional electric generating capacity in the area in order to adequately supply estimated future loads, the location, size and type of generating plants to be constructed, the transmission system needed to carry the output of the generating plants to load centers, and the value of the output of the proposed projects under consideration based on cost of power from the lowest cost alternative source.

The National Power Survey

As most of you know, the Commission now has under way a National Power Survey. This is quite a large undertaking and could well be the subject of a separate paper. Briefly, it is an intensive study of the nation's power requirements and supply arrangements in order to set forth broad technical and economic guidelines for the future. The survey will propose voluntary guidelines to aid the industry in meeting its requirements to 1980 as efficiently as possible from a national point of view. The goal is to develop a pattern of future power supply that will meet the nation's electric power requirements at the lowest possible cost. We expect to complete the survey by the end of calendar year 1963.

The Commission is receiving the full cooperation of all segments of the power industry in conducting this survey. A system of national and regional advisory committees, with total membership of about 120, has been established to make intensive studies of a wide variety of technical, economic, and legal problems. Representation on these committees includes men from both privately and publicly financed power systems as well as the Federal planning, constructing, and marketing agencies, such as the Corps of Engineers, Bureau of Reclamation, TVA, BPA, SWPA, and SEPA.

The studies already made indicate that the power requirements for 1970 will be about twice the 1960 requirements and those for 1980 will be about 3.6 times the 1960 requirements. We anticipate that the meeting of these enormous loads economically will require full use and extension of the recent advances in power technology. This will include the construction of steam-electric generating units of 1,000 megawatts or more of capacity and strong interconnections between areas and regions with EHV transmission lines. Large nuclear plants are also showing promise of economies in power production.

Studies are now being made of possible savings through inter-regional interconnections which can take advantage of load diversities, provide for pooling of reserves, and utilize lowest cost sources of generation. A good example of such an arrangement is the interconnection which has been planned and is now in the process of construction between TVA and the Southwest -- a 500-kv transmission system which initially will send 1,500 megawatts of power westward in the summer to assist the Southwest in meeting its warm weather peak and 1,500 megawatts to the east in the winter to assist TVA in meeting its cold weather peak. There are a number of similar opportunities throughout the nation for such exchanges -- and as regions progress in industrial development, in application of electric uses for home heating and air conditioning and as relative population densities change, we can expect to find a continual shifting in the balance between regions of peak loads -- an important consideration to bear in mind in planning major inter-ties.

The rapid past and anticipated future rate of growth of power loads and the installation of increasingly larger-sized thermal units, which must operate at high plant factors for best efficiency and economy, have accentuated the need for peaking capacity. Planning to meet such needs includes the reappraisal of available hydroelectric power sites, from the widest possible viewpoint, as well as the consideration of possible pumped storage developments.

Hydroelectric projects, whether of the conventional or pumped storage type, are well adapted for peaking and reserve uses on the power loads. Among the reasons favoring hydroelectric plants over other types of plants for such use are: (1) Ease of operation; (2) quick start and shutdown, particularly useful for handling sudden

changes of load without interruption of system capacity; (3) low maintenance cost; (4) minimum manpower for operation; (5) adaptability for remote control or automatic operation; and (6) long life.

In the reappraisal of sites for conventional hydroelectric power development, the need for peaking capacity has resulted in planning for increasingly lower plant factor operations. For many years the designs for peaking plants have used plant factors substantially below system load factors. Recently a large plant has been placed under construction in the Southeastern Region to operate at an average plant factor of about five percent. Other similar designs are contemplated at favorable sites where large fluctuations in flow releases can be tolerated. With such planned operation, project sites previously considered infeasible of development may now be found to be capable of economical power development. Even in the Pacific Northwest where the bulk of the load is now supplied by hydroelectric power, new plants are being designed for eventual peak-load use in conjunction with large amounts of capacity expected to be provided by thermal plants.

With large power loads and large unit sizes of thermal units, planned hydroelectric plants must be of substantial size to be utilized effectively for peaking purposes. This in turn requires use of the largest practicable sizes of units in the hydroelectric plants. The use of such large equipment results in lower unit capital and operating costs.

Although conventional hydroelectric power is and will continue to be an important factor in the power supply of the United States, its share of the total installed generating capacity has been and will continue decreasing over the years. Not only are loads increasing faster than potential water power sites can be developed to supply peaking power needs, but also the increasing demands for water resource development for such purposes as water supply, pollution control, and recreation, will restrict the use of available sites for power purposes. This will result in greater consideration in the future of other sources of peaking power, including pumped storage developments.

Our preliminary studies indicate that the nation's present installed hydroelectric capacity of about 38 million kilowatts will be approximately doubled by 1980, considering conventional hydro plants only. In addition, it is anticipated that more than 10 million kilowatts of pumped storage capacity will be in operation by that date.

The inevitable and probably fairly early interconnection of areas and regions by high voltage transmission systems will permit expanding the concept of load areas to be served and type of power

product that can be utilized. It does seem that, consistent with the physical conditions at hand, the time is here when we should abandon any remains of a limited view of project development.

Headwater Benefits Investigations

Another important Commission function relating to water resources is the making of headwater benefits determinations. Section 10(f) of the Federal Power Act directs the Commission to determine annual payments to be made to the United States or a licensee by the owner of a non-federal power project, whether licensed or not, which is directly benefited by a storage reservoir or other headwater improvement constructed by the United States or a licensee.

In past years headwater benefits investigations, which provide the Commission with information necessary for the determination of annual payments, have been made after the fact, that is, on the basis of reservoir operations which have actually occurred. Investigations made on this basis must be continued year after year for each project as long as the projects involved are in operation and benefits are provided. When payments have been determined for a particular year the investigation is completed for that year but the investigation must be continued so as to determine the payment required for the following year. In order to eliminate much of this repetitious work, the Commission has recently adopted new regulations to provide for the use of formulas to represent average conditions and to provide for continuing annual billings to each company for headwater benefits. This procedure should materially expedite the headwater benefits work.

Rates and Cost Allocations

Under provisions of the Flood Control Act of 1944 and other acts, the Commission is required to approve rate schedules for the sale of electric energy produced at certain Federal projects for which the Department of the Interior is the marketing agency. Principal among these projects are the multiple-purpose developments constructed by the Corps of Engineers.

Under the Bonneville, Fort Peck, and Eklutna Acts, the 1945 River and Harbor Act, and the 1954 Flood Control Act, the Commission has specific authority with respect to cost allocations for certain Federal projects, namely, Bonneville, Fort Peck, Eklutna, McNary, four projects on the Lower Snake River, and the Canyon project. In the case of other multiple-purpose projects constructed by the Corps of Engineers, the Corps as the construction agency, the Department of the Interior as the marketing agency, and the Federal Power Commission as the rate-approving agency, all have a direct interest in the allocation. Lacking specific authority, the Federal agencies concerned undertake jointly to consider allocations of cost. Thus, the Commission staff participates with the representatives of these agencies in cost allocation studies of such projects.

Evaluation of Hydroelectric Power

In its river basin planning studies, the Commission uses project formulation and evaluation procedures that are generally in accord with the principles of the May 1958 "Green Book." It also utilizes procedures set forth in Senate Document No. 97, 87th Congress. Commission staff instructions covering certain of these matters are included in the Bureau of Power's Technical Memorandum No. 1, entitled "Instructions for Estimating Electric Power Costs and Values," dated March 1960, as amended and supplemented.

The benefits of power produced by a hydroelectric project are the value of the power to the users as measured by the amount that they would be willing to pay for such power. For most areas of the United States it may be assumed that power to meet the power demands could be obtained from alternative sources. Normally, therefore, the cost of power from the most likely alternative source provides a measure of the value of the power creditable to the project. In view of the predominance of new steam-electric capacity being installed in most sections of the country, it is generally appropriate to evaluate the output of hydroelectric projects on the basis of the cost of equivalent amounts of capacity and energy from modern steam-electric plants, giving due consideration to such differences as transmission losses and annual transmission costs.

As explained in Technical Memorandum No. 1, the value of hydroelectric power is normally expressed in terms of two components: (1) a capacity value, which corresponds to the fixed elements of the cost of power supply from alternative new steam-electric plants; and (2) an energy value, which corresponds to the variable elements of the cost of power supply from such alternative plants. These capacity and energy components of power value are usually expressed in terms of dollars per kilowatt per year of dependable capacity and mills per kilowatt-hour of average annual energy, respectively.

The capability of a hydroelectric plant to which capacity value is assignable is its dependable capacity. The dependable capacity of a generating station is defined as the load-carrying ability for the time interval and period specified when related to the characteristics of the load to be supplied. It is determined by such factors as capability under adverse water conditions, operating power factor, and portion of the load which the station is to supply. For a hydroelectric plant having power storage the dependable capacity may vary over the life of the project as a result of changing use of the available storage. Studies indicate that in many instances the average dependable capacity of a storage hydroelectric project over a 50-year period could conservatively be estimated as the capability at the originally selected maximum drawdown, plus one-half of the difference between that capability and the installed capacity.

In estimating the value of dependable capacity available from a potential hydroelectric plant, as measured by the cost of capacity from alternative steam-electric plants, consideration should be given to the relative system reserve requirements, operating flexibility, service availability, and other factors relating to the two types of plants. Some hydroelectric plants are particularly well adapted for serving peak loads and operating as synchronous condensers or as spinning reserve. Under favorable water conditions they may supply capacity in excess of their dependable capacity, making possible savings in overall system costs. Also, in contrast to the relatively simple hydroelectric plant involving rugged machinery operating at low speeds and temperatures, the modern steam-electric plant is an intricate and complex mechanism involving high-pressure, high-speed, and high-temperature equipment, and it is subject to more equipment outages for maintenance and repair. These considerations and others less tangible are difficult to evaluate, and so are matters which must be determined largely on the basis of judgment.

Frequently, consideration of these factors will indicate that a credit to the hydroelectric project is warranted. Such a credit, or hydro-steam capacity value adjustment, may range up to the equivalent of ten percent of the at-market cost of steam-electric capacity, but is normally equivalent to about five percent of such cost. The adjustment would be zero, however, in any case where transmission facilities included in the hydroelectric plant development program would not provide service as dependable as those contemplated for the alternative steam-electric plants. When a hydro-steam capacity value adjustment is warranted it should be applied to the at-market capacity cost of the alternative steam-electric power. The adjusted cost would be the at-market value of the hydroelectric power capacity.

When using the incremental cost of energy from alternative steam-electric plants in computing hydroelectric energy values, attention should be given to the energy cost differential that may exist if the average annual plant factor of the proposed hydroelectric plant is different from that at which the alternative steam-electric plant would be expected to operate. As the annual plant factor of the alternative steam-electric plant is likely to decrease with time, it is necessary to use a plant factor averaged over the service life of the steam-electric plant rather than the plant factor at which such plant would operate initially. When the average annual plant factor of a hydroelectric plant is less than that at which an alternative steam-electric plant would operate over its lifetime, system operating studies will usually show that the older and less efficient steam-electric units in the system would operate at higher capacity factors than would be the case if the alternative steam-electric plant were constructed. This would result in an increase in average steam-electric energy production costs which should be considered when computing the value of the hydroelectric energy.

If, as occasionally happens, the average lifetime plant factor of the hydroelectric plant is greater than that of the alternative steam-electric plant, then the effect of constructing the hydroelectric plant would be to decrease the average production cost of steam-electric energy. To compensate for such differences in the average incremental energy cost of system steam-electric plants, an adjustment is made, when necessary, to the hydroelectric energy value. The effect of this adjustment is to decrease the hydroelectric energy value when the annual plant factor of the hydroelectric plant is less than that of the alternative steam-electric plant. When the reverse is true, as is less likely, the effect is to increase the hydroelectric energy value. For convenience in computations the adjustment is usually applied to the at-market cost of the steam-electric energy. The adjusted cost would be the at-market value of the hydroelectric energy.

The transmission facilities selected to transmit power to the market from a hydroelectric project, or from an alternative steam-electric plant, should have sufficient capacity to carry the maximum output of the plant. For purposes of estimating the investment cost of transmission facilities for steam-electric power plants considered to be alternative to hydroelectric plants, as much attention should be given, in making the estimates, to the location and arrangement of such facilities as is given to those for the hydroelectric plants. This is to assure that a reasonable circuit layout is provided to supply power to comparable delivery points. Many of the newly constructed steam-electric plants are located at some distance from load centers to take advantage of low cost sites, ample water supply, economical fuel supply sources, and areas not likely to have smoke-nuisance ordinances. It has been found in a number of cases that the unit investment for transmission facilities of such plants is comparable in magnitude to that for many hydroelectric plants.

In computing at-site power values for a proposed hydroelectric plant, the first step is to derive the alternative steam-electric plant costs which are then modified by the costs of transmission and power losses to arrive at the cost of steam-electric power at the market. Through the application of the hydro-steam capacity and energy value adjustments, the cost of steam-electric power at the market is converted to the value of hydroelectric power at the market. Finally, these values are reduced by the cost of the hydroelectric transmission facilities and power losses to obtain the unit at-site capacity and energy values of the hydroelectric power. Attachment No. 1 to this paper (page 158) is an example of a power value computation.

Annual Cost of Hydroelectric Power

The investment in hydroelectric projects per kilowatt of installed capacity varies greatly according to the type of project, its size, location, amount and cost of land required, and the cost

of relocation of facilities within or adjacent to reservoir areas, such as railroads, roads, bridges, and communities. The total annual cost of a hydroelectric project consists of fixed charges on the project investment; production expenses, consisting of operation and maintenance costs; and the allocated administrative and general expense.

The components of fixed charges are cost of money or interest; depreciation or amortization; interim replacements; insurance; and Federal, State, and local taxes where applicable. These items are all related to the project investment and may be expressed as a percentage of this investment. A life of 100 years is used for the dam and reservoir unless a shorter life is expected because of physical reasons. A 50-year period of analysis is used for all power facilities except the dam and reservoir. The annual fixed charges for Federally-financed hydroelectric projects as currently used in Commission studies are as follows:

	Dam and Reservoir	Specific Power Facilities
	(Percent of Investment)	
Interest	2.875	2.875
Amortization	0.179	0.920
Interim replacements	0.050	0.400
Insurance (in lieu of)	0.002	0.200
Total	3.106	4.395

In formulation and evaluation studies for a single-purpose hydroelectric development, the total project benefits and costs would be used. For a multiple-purpose development, however, the incremental, or separable, costs of including power in the project would be used in considering whether or not to include power as a purpose. Such incremental costs would include those for the powerhouse and equipment as well as those for any additions to the dam and reservoir resulting from the inclusion of power. (A sample calculation is shown as Attachment No. 2, page 159). However, these costs would not, except in the case of projects of marginal economic feasibility, represent the amount that should properly be assigned to power for rate and repayment purposes. Power costs for those purposes would be determined by means of a cost allocation.

I will conclude these remarks by observing that the proper planning of our river basins is a big job and a long-range job; it is a tremendously important job. It will require the best efforts of all of us.

DERIVATION OF UNIT POWER VALUES FOR A HYDROELECTRIC PROJECT SITE

On the basis of cost of equivalent power from a privately financed fuel-electric plant, and assuming federally-financed transmission of hydro power to market. (Based on procedures in Tech. Memo. No. 1)

Alternative Fuel-Electric Plant Assumptions:
Plant size 1,500 mw (3-500 mw units)
4,500 hrs. operation per yr.
Heat rate, 9,000 btu/net kwh
Fuel cost, 25¢/million btu (coal)

At site cost of fuel-electric power.....Plant Investment..... $140/kw

Annual capacity cost:

Fixed:			
Interest		6.25%	
Depreciation, 35 yr.		.85	
Interim replacements		0.35	
Insurance		0.25	
Taxes 1/		5.72	
		13.42%	$18.79
Fuel stock (110 days) 12.2 million btu @ 25¢	@	6.25%	0.20
Fixed Operating:			
Fuel, 4.05 million btu 2/ @ 25¢		$ 1.01	
O&M (incl. adm., & gen.)		1.36	2.37

plus

- Total capacity cost..... $21.36/kw

Energy cost

Fuel (9,000-900) btu @ 25¢	2.03 mills/kwh
O&M	0.13

- Total energy cost..... 2.16 mills/kwh

Transformation and Transmission..... (20 mi., double circuit, steel towers, 500 kv)

Sending substation investment		$ 4.60/kw
Lines	"	2.00
Receiving "	"	3.60
		$10.20

Annual capacity cost:

Fixed:				
Interest	6.25%	$ 0.64		
Depreciation	3/	0.08		
Interim replacements	4/	0.03		
Insurance	5/	0.02		
Taxes 1/	5.72%	0.58	$1.35/kw	
O&M(incl.adm. and gen.)			0.20	
Losses, converted to $/kw)			0.50	

- Total capacity cost..... $2.05/kw
- Energy cost, equivalent derived from loss percentages..... 0.03 mills/kw

equals

At market cost of fuel-electric power.....$23.41/kw
2.19 mills/kwh

equals

At market value of hydro power..... Add 5% capacity advantage factor.....$24.58/kw
Energy, deduct 0.1 mill/kwh 2.09 mills/kwh

minus

Transformation and Transmission..... (50 miles 2-single circuit H-frame 110 kv)

Receiving substation investment	$ 1.35/kw	
Lines "	11.00	
	$12.35	

Annual capacity cost:

Fixed:			
Interest 2 7/8%	$ 0.36		
Amortization 1.69%	0.21		
Interim replacements 6/	0.03		
Insurance 5/	0.01		
Taxes (not included)	-	$ 0.61/kw	
O&M (incl. adm. and gen.)		0.67	
Losses, converted to $/kw		0.60	

- Total capacity cost.....$ 1.88/kw
- Energy cost, equivalent derived from loss percentages..... 0.03 mills/kwh

equals

At site value of hydro power 7/.....$22.70/kw
2.06 mills/kwh

1/ Fed. income 3.23%, State and local 2.39%, misc. 0.1%.
2/ About 10% of year's consumption.
3/ Substations 0.85%; lines 0.32%.
4/ Substations 0.35%; lines 0.1%.
5/ Substations 0.25%; lines 0.1%.
6/ Substations 0.35%; lines 0.2%.
7/ These at site values are at the high tension terminal of the substation.

ATTACHMENT 2

EVALUATION OF HYDROELECTRIC POWER DEVELOPMENT

AT A FEDERAL MULTIPLE-PURPOSE RESERVOIR PROJECT

(Installed Capacity, 200,000 Kilowatts)

Power data

Installed capacity	200,000 kw
Dependable capacity (50 yr. average)	190,000 kw
Capability at minimum head (initial)	180,000 kw
Minimum yr. output	196 million kw
" " load factor (initial)	12.5%
Average yr. output	390 million kw
" " plant factor	22%

Power investment

Construction cost, project without power	$66,000,000
" " project with power	139,800,000
Power construction cost, equals difference	73,800,000
Power investment	78,000,000 1/
Power investment, specific, 200,000 kw @ $180	36,000,000
" " other, raising dam, etc.	42,000,000
Power investment	78,000,000 1/

Annual power costs

Fixed, $36,000,000 @ 4.395% 2/	$1,582,000
$42,000,000 @ 3.106% 3/	1,304,000
" subtotal	$2,886,000
Operation and maintenance, 200,000 kw @ $2.57 4/	514,000
Total	$3,400,000

Annual power benefits

Capacity, 190,000 kw @ $22.70	$4,313,000
Energy 390,000,000 kwh @ 2.06 mills	803,400
Total	$5,116,400

Benefit-Cost ratio of power development **1.50**

1/ Includes, int. during construction, at 2 7/8%, ½ of 4 yrs.
2/ Int. and amort., at 2 7/8%, 50 yrs., plus 0.6% replacements and ins.
3/ " " " " " 100 yrs., plus 0.052% " " "
4/ $1.90 plus 35% administrative and general

THE ROLE OF STATES IN RIVER BASIN PLANNING

by
Harold G. Wilm, Commissioner
New York State Department of Conservation
and
Charles F. Schwan, Jr., Director
Washington Office, Council of State Governments

Introduction

Your week-long seminar covers a wide spectrum of governmental responsibilities in river basin planning. Nominally, my task is to be confined to the role of the States - in contrast, I suppose, to the responsibilities of local and Federal Governments. Because of the key role of State governments in both local and national affairs, however, it seems necessary for me to touch upon Federal-State and State-local relationships in the process of talking about State responsibilities themselves. Also, perhaps I may be permitted to talk in broader terms than just river basin planning, as I deal with these relationships.

Therefore the objects of my discussion will be first, to review briefly the history of Federal-State relations in recent decades; to suggest a general philosophy on responsibilities of various levels of government; and then to indicate my conception of state responsibilities in river basin planning.

History

During the last three decades, the Federal Government has acquired an unprecedented degree of influence upon domestic affairs at all levels, from the individual farmer and his family on up to major interstate programs. These burgeoning influences have been aided by various authorities granted by the Congress, for the Federal Government to provide financial rewards to people and to governmental units.

The original reasons for these Federal activities were quite sound. First was, of course, the onset of the Great Depression, during which many millions of people needed assistance which, in most cases, the States were unable to provide to an adequate degree. At that time the governments of many of our States lacked maturity and ability to take leadership; they also lacked finances and staffs to handle important programs. Also, President Roosevelt encouraged the growth of Federal programs throughout his administration. Then, in spite of President Eisenhower's comparative conservatism, the trend continued. As illustrated especially by his frustrations over the burgeoning farm programs, it is difficult for even the President to cope with a mass of existing legislation, any changes in which are opposed by organized lobbies. Finally, the present administration seems to be encouraging the resurgence of a strong Federal role, including provisions for large additional subsidies to states,

localities, and individuals - if we are to judge by administration-sponsored bills now being considered or before the Congress.

These trends can be undesirable if, as may happen, they lead to an undesirable degree of paternalism; concentration of authority at the Federal-level; and, in some cases, an actual weakening of our over-all capacity by overloading the Federal Government with responsibility. Some strong counter-influences are now at work, however, which were absent thirty years ago. Most important, I think, is the increasing maturity of States and State governments, and a growing willingness to assume responsibility at state and local levels. Especially in the younger Western States, these last thrity years have provided time for substantial development in the magnitude and responsibility of State governments. The growth of these counter-influences is, I imagine, also strengthened by local and state resistance to the mounting costs of Federal Government.

Another important counter-influence, generated from those just mentioned, is the coalition of the states through the Council of State Governments. This organization has been in operation and influential for many years, but has not often developed the focused majority power that is needed for real influence on interstate and national affairs.

In very recent years, water-resource planning and development have provided problems of general interest to all States. As a result, many States supplied welcome support leading toward the passage of Federal legislation on the Delaware River Basin Compact. Also, through the Interstate Conference on Water Problems, the States exerted weighty forces upon proposed Federal legislation, especially the "President's Water Resources Planning Act of 1962" (S. 2246). Also in 1962, rapid action by the states and by non-governmental organizations effectively stopped the President's bill which would have provided for a land acquisition fund, financed by several methods including a Federal boating tax. In both cases, more satisfactory bills are now before Congress. About the revised water resources bill, S. 1111, I shall have more to say later.

Philosophy

Implicit in the above discussions of Federal-State relations is my basic philosophy - and that of our administration in New York State - that government should be conducted at the lowest practical level, starting with the individual family. Above the family level, the philosophy in New York State has long been to keep responsibility in local government, as far as possible. There is even in our State a very strong Office of Local Government, whose major responsibility is to assist local governments to establish and maintain their own responsibilities. It is our conviction that the major role of state government is in the conduct of regional, statewide, or interstate affairs; and in providing assistance to local governments where these are not financially or socially able to meet a problem.

standards and guidelines for local action, and to avoid any semblance of domination.

Obviously this same philosophy can and should be extended to Federal-State relationships. If a State is financially or governmentally incapable of meeting a major problem, especially one which has interstate significance, other states should be willing to assist it - either through interstate cooperative arrangements, or through the medium of the Federal Government. Where it is necessary for the Federal Government to provide leadership, guidance, or assistance, however, again this top level of government should be extremely meticulous not to convert leadership into domination. This difference between domination and leadership may be illustrated by the following quotation from a letter written to me by a highly-placed member of the present Federal administration (speaking of water resource planning and development): "If a State wants to preserve its unquestioned rights it must pay for its own projects. If it wants Federal money it must surrender some of its rights." In reply, I commented "I can agree only to the extent that acceptance of financial aid, justified by regional or national benefits, must require conformance to rules that are based on regional or national needs. I emphatically do not agree that such assistance must mean federal leadership or domination over natural-resource planning and development - in spite of 'precedents' that occurred during the 1930's and 1940's." It may be added that the term "federal money" could also be reiterated. In a broad sense "federal appropriations" are simply the reallocation of tax money to segments of the nations population, with federal agencies serving as the mechanisms.

The need for the States to assume leadership and responsibility in recreation as well as in other natural resources was pointed out emphatically by the recent report of the Outdoor Recreation Resources Review Commission, headed by Laurance Rockefeller. While this report describes the obviously large responsibilities of the Federal Government in recreation, it also gives particular emphasis to the responsibilities of the States in this field, with any necessary assistance and guidance from the Federal Government. This, from our viewpoint, is sound governmental philosophy. Obviously the degree of assistance in guidance in the Federal Government will vary from state to state, depending upon the degree of maturity as will the social and financial capability characterizing each State.

The States and River Basin Planning

Mention has been made of the Interstate Conference on Water Problems. This young organization, associated with the Council of State Governments, is made up of officials concerned with all phases of water resources administration. Among its participants are representatives of all states and of all types of state agencies with responsibility for water resources planning, regulation, conservation, development and utilization. As a result of the broad interests of its participants, the Conference has been particularly concerned with the need for coordinated, comprehensive planning for development of water and related land resources. Although I am here today as an individual, I am Chairman of the Policy Committee of the Conference and,

in a sense, I speak for it.

I believe the simplest way for me to proceed would be to describe the evolution of S. 2246, the administration water resources planning bill of the last Congress, into S. 1111, the current bill. By so doing, I believe I can indicate what the Conference feels should be the role of the states in river basin planning. As you will also see, the Conference view of the role of the states is shared by most Governors and many other state officials and legislators.

Shortly after introduction of the administration water resources planning bill in July 1961, the Council of State Governments sent to all Governors, state water resources administrators, other officials and legislators a memorandum commenting on the bill. Later in the year, a questionnaire, prepared by the Council and the Interstate Conferences, was sent to all Governors and state water resources administrators. This questionnaire was an extensive one, asking not only for comment on major provisions of the bill, but also offering for comment on various alternatives to such major provisions. Well over half the Governors had replied to the questionnaire when, in January 1962, the Interstate Conference on Water Problems held its annual meeting in Dallas - a meeting devoted primarily to discussion of coordinating water resources planning. On the basis of the survey and its own deliberations, the Conference directed its Policy and Executive Committees to consult with appropriate persons in the federal executive and legislative branches in an effort to revise the bill.

In March 1962, representatives of the Conference appeared before the Senate Interior and Insular Affairs Committee. They offered for consideration a revised draft of the bill. It was at that hearing that the then Chairman of the Committee, Senator Clinton Anderson directed that its staff work with representatives of the Conference to develop a bill which would, in his words, "let State and federal planners proceed to work out together, much-needed, comprehensive development plans." I should add that the Governors' Conference in July 1962, and the Interstate Conference on Water Problems in December 1962, confirmed their previous expressions of the need for such legislation.

With this direction and inspiration - and many hours of very hard work over a period of about a year - a bill was developed, S.1111. It was introduced by Senator Anderson and others on March 15. It is one which the states endorse with enthusiasm. It is one which can point the way toward better coordination between the Federal Government and the states in an area in which both levels of government have vital interests - water resources planning. Having helped in the development of this legislation, I should like to add that the federal and state representatives with whom I worked showed a spirit of cooperation and understanding that federal and state representatives on river basin commissions would do well to emulate.

The states endorse heartily the policy objectives of S. 1111. We believe that there must be comprehensive and coordinated planning in the conservation, development and utilization of our water and related land resources. We believe that comprehensive and coordinated planning can be achieved only with the cooperation of all affected Federal agencies, States, local governments and others concerned. Finally, we believe that S. 1111, if enacted, will achieve its stated objective.

The heart of the bill, so far as the states are concerned, is title II. It provides for the creation of water resources planning commissions for regions, river basins or groups of river basins. So that the record may be clear, let me say that we recognize that the river basin commissions contemplated by the bill may not be suitable in every area of the country. For that matter, S. 1111 provides that it is not to be construed ". . .to displace, supersede, or limit the jurisdiction or responsibility of any legally established joint or common agency of two or more States, or of two or more States and the Federal Government; . . .not to limit the use of other mechanisms, if preferred by the participating governmental units, in the water resources field;. . . ." What is more, no commission may be created in an area without the concurrence of both the federal Water Resource Council and at least half of the states concerned. It is entirely conceivable that the coordinating mechanism of the bill would not be appropriate in a given area. For that matter, it is conceivable that, as among the views of the relevant federal agencies and the states in a given area, there exists such a great distance from a consensus that no coordinating device would be operable.

Title II embodies the concept that river basin commissions are to be neither federal nor state agencies, but joint agencies of the two levels of government. As I remarked, a commission will be created only with the concurrence of the Water Resources Council and at least half of the affected states. This is just as it should be. Effective planning requires recognition that major responsibilities in the development and management of our water resources inhere in both the Federal Government and the states. This division of responsibility makes it necessary that the legal framework employed for river basin commissions be truly federal-state in character. As Interstate Conference representatives testified about a year ago, "Since both the Federal Government and the states have and will continue to have basic responsibilities for planning and development, conservation and use of our water and related land resources, any general authorization for coordinating mechanisms should envisage joint agencies. This is the only means of avoiding the subordination of either level of government, while safeguarding the legitimate role of each. . .."

In passing, I should point out that if sufficient state concurrences are not obtained in a given area within a reasonable time to effectuate a request of the Council that a commission be created, the Council may recommend an alternative means to accomplish the planning goal for the basin or region concerned.

Commissions will be made up of representatives of the Federal Government and affected states and, where appropriate, interstate agencies and international commissions. Such representatives will be appointed by, responsible to and compensated by their respective agencies and jurisdictions. Plans developed by commissions will be sent for comment to federal agencies, Governors and to each interstate agency and international commission. Final plans and major revisions will be submitted to the President and by him to Congress, and to Governors and legislatures of the participating states.

The joint federal-state concept is furthered by the provision that commission expenses will be shared by the Federal Government and each of the participating states in such proportion as the commission shall determine. In employment of personnel, too, the federal-state nature of the commission is to be seen. Commission personnel will be appointed and supervised by the chairman and their duties and responsibilities assigned by him. In addition, a commission may arrange for the services of personnel from any federal, state, interstate or local agency. It may also arrange with any participating government for coverage of its employees in any retirement and employee benefit system.

The chairman, an appointee of the President, and the vice chairman, elected by his fellow state members, are assigned special responsibilities to represent the federal and state members respectively on matters of federal-state relations. When voting is necessary, only the chairman, acting on behalf of the federal members, and the vice chairman, acting upon instruction from the state members, will be eligible to vote.

These voting arrangements may cause some surprise, but they are consonant with the nature of the work involved. First, there should be few occasions for voting. This is physical planning which is based on factual data, most of which are not open to more than one interpretation. And certainly in those cases where two interpretations are possible, there is no reason to suppose that one segment of a commission will vote on the basis of "federal" facts, another on the basis of "state" facts. Second, although there are but two members who are eligible to vote and agreement between them must be obtained, there is no reason to assume an impasse because of the absence of a "tie breaker." Surely most commission decisions will be reached by a process of discussion which leads to a consensus. Presumably, to reach a consensus, some compromises will have to be made, but are not discussion, compromise and consensus the essence of a successful planning process? Finally, in making major decisions for so fundamental a resource area as a river basin or region the result should not be determined by the narrowest of arithmetic margins possible. They should represent substantial agreement among the participants. Until the planning process achieves the necessary reconsiderations to permit a high degree of agreement there may be genuine reason for not reaching a final decision.

As we envision a plan that might be submitted, it may be one on which complete agreement has been achieved. Another plan might include certain elements on which there was lack of agreement. In

such a case, alternatives might be presented to the President, the Congress and the states involved. If there appeared to be no possibility of agreement, then an alternative means of planning might have to be employed. Even in such a case, an effort would have been made under the best possible circumstances to reach a consensus among representatives of the Federal Government and the states involved.

To sum up - what is proposed is an enabling act, not a panacea. It is not meant to disturb the jurisdiction or rights of the Federal Government or of the states. It is intended to provide a means or mechanism for coordinated federal-state planning for the conservation, development and utilization of the water and related land resources of the nation. It is not suggested that this is the only means to this end - but it is one means. Enactment of S. 1111 will not disturb any legally established intergovernmental instrumentality operating in the water resources field. It will not - nor could it - limit the authority of Congress to authorize or fund projects. Similarly, state authority to authorize or fund projects is unaffected by the bill.

Finally, this act will not interfere in any way with established federal or other mechanisms for putting into action the programs and projects that are the products of a river basin plan.

In conclusion, I should like to say that we favor the enactment of S. 1111 as soon as may be possible. Long overdue is the perfecting of mechanisms to plan the conservation, development and utilization of our water and related land resources on a comprehensive and coordinated basis. Enactment and implementation of the legislation can meet this need. It is a long and wise step forward in water resources planning and in federal-state relations. We hope it will not be long delayed.

GENERAL APPROACH TO APPRAISAL OF NEEDS

by
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Southwestern Division, Corps of Engineers, Dallas, Texas

1. To appraise the needs of our river basins with intelligence and reasoned judgment we must be thoroughly conversant with national goals and administration policies related to the water resources field. These are set forth in Senate Document No. 97 and messages of the President on Natural Resources (H.D. 94/87/1) and on Our Conservation Program (H.D. 348/87/2). Administration views on water and land resources are usually covered in the President's State of the Union messages to Congress. Mr. Weber and others have summarized these objectives. For an insight into these matters we should also be familiar with the Economic Reports of the President which are published with The Annual Reports of the Council of Economic Advisors. Certain aspects of these publications are germaine to our planning efforts. For example, the items applicable to appraisal of needs relate to "our goal of full and sustained prosperity without inflation" and "our goal of economic growth" and "budgetary policy." Many other publications are available as to national goals and water resources planning policies. In times past, it was sufficient for only top management people to be conversant and have depth of understanding with these broad aspects of planning. In this explosive and dynamic age, all levels of planners should be conversant with these matters so we can approach the subject of needs intelligently, comprehensively, and systematically. Regional and local goals, if different than national goals, should be developed and comprehended.

2. We should realize, however, that water related goals, objectives, and policies have not developed over a period of the last few months but rather that today's goals and objectives represent the culmination of efforts over a great many years. Most of you that are in attendance at the seminar, with a few who have preceded you, have been involved in the development of this phase of government operations. A good deal of the water policy of the United States has been established by the people attending this seminar. The Corps has been engaged in this business of establishing needs for a long time. We have a knowledge in the field, we have experience in the field, and we certainly have people highly qualified to continue our leadership in this area of effort. We find ourselves, however, in a period of broadening our

concepts; a period of realignment of our own thinking on such matters as the full realization of the importance of the management of water to create a usable resource; the growing importance of the team approach to river basin planning; the awareness that planning for water resources development must be efficient in the sense that projects meet the needs of the people with a minimum consumption of real wealth and that such projects are timely to insure that lack of water or lack of any of the services which water can provide will not constitute a drag upon the basin's economic growth; and, finally, the realization that we must correlate and translate the traditionally used engineering terms of needs for flood control, navigation, irrigation, water supply and other project purposes into meaningful economic expressions of how these project needs are related to national goals for economic growth and development of each region within the country to maintain national strength and the achievement of satisfactory levels of living.

3. There should be an emerging realization that the needs for flood control, navigation, irrigation, water supply, and all other project purposes are intermingled and interwoven with the national needs, goals and objectives arising from economic growth. It is in this area of needs that our concepts seem to need sharpening. There should be a growing realization that more high level systematic planning should be focused in the area of needs than has been accomplished in the past. We are highly efficient in the tuning-up process of getting an inventory of all existing water and related land resources. We can easily compile records of all streams and their topography. We can gather data on the climate, the vegetation, and the hydrology--river by river and stream by stream. Information can be developed about the existing population, industry, occupations and present land use and extent of irrigation development. We are adept at the collection of available data on water supply, electric power, transportation, recreation, water quality and forest products and mineral resources. We have a vast knowledge and inventory of existing water and related land resources and an inventory of basin developments and the water requirements and water services which these developments satisfy.

4. To plan for today's needs or even 10 or 15 years hence is not enough. The growing population and the growing levels of living standards require more intelligent and reasoned planning to keep needs and development of resources in step. Expectations of many people for economic growth in the years ahead are based on United States population trends. During the 70-year period from 1890 to 1960 the average annual rate of population growth was 1.50 percent. The average annual rate of increase between 1960 and 2070 was estimated in the study on the Trinity River to be 1.40 percent. In the United States, unlike undeveloped countries, a growing population means economic growth because the people have an enormously productive economic machine to work with. Reliable statistics on the gross national product of the United States (the most comprehensive measure of the country's economic state) do not go back very far, but the best evidence we have is that in 1909 the GNP in 1954 prices was about $100 million, or $3,000 per person employed and a bit over $1,000 per person in the population. Almost half a century later

in 1957 the GNP had quadrupled. During the same period the labor force and the population doubled so that output per head doubled. In terms of rates of growth per year the GNP increased about 3% on the average, and 1½% per year per person. Real GNP between 1947 and 1960 rose at a rate of 3.4% per year in total and 2.2% per year per person employed. These are higher than the historical rate of 3 and 1½% (the difference between GNP growth at 3% and at 3½% amounts to 2½ billion dollars of national product in one year--$15 billion in 5 years, $33 billion in 10 years). Between 1947 and 1953 real GNP actually increased by 4.3% per year on the average. Since 1955 the potential output of the American economy was growing at about 3½% per year. As you know, the national goal is an annual growth rate of 4.5 percent for the GNP. These statistics are cited to help us envision the tremendous potential growth we can expect in the United States and the spectacular task before us to size up the needs in terms of water and services provided by water. It should be crystal clear that planners under present-day concepts must broaden their viewpoints to appreciate the factors that influence the economy of the country and be prepared to understand the jargon of the economists and relate such understanding to intelligent and efficient planning for river basins.

5. Another indicator of economic growth is personal income which is the principal component of the GNP. It is often used as an indication of growth because these data are generally more available. At the national level it has been found that personal income exhibits the same average annual growth that characterizes the trend of the GNP. There is no single index of the standard of living. Per capita disposal income (after all personal taxes) comes close. This figure is now in the neighborhood of $2,000 in terms of 1961 prices. This is 16% upward in less than 8 years. In the 8 years ending with 1954 it rose less than 7%. The $2,000 figure on the statistical American's ultimate ability to buy the goods and services of life is now nearly double the $1,200 figure of pre-war 1939 ($540 in terms of 1961 prices). There is an abundant evidence of how this great growth and real buying power has bettered the lot of the American citizen. An associated result is the accelerated growth of consumer products which has far outspaced the population rise. For example, since 1955 the United States population has increased 12% while the number of motor vehicles in use has climbed 24%. Economic growth in terms of real wealth is sensitive to the latent consumer's desires. For example, if consumers would spend one percentage point of their disposal income, retail sales would rise more than 3¼ billion dollars on an annual basis.

6. To supply the growing wants of Americans industry has carried out a vast expansion program. Rapidly rising research and development spending in recent years has laid the groundwork for further betterments in living standards. Expenditures on research and development in 1961 approximated $15 billion, nearly 3 times the expenditures in 1953, or 2.8% of GNP. In 1947 research and development was still a small dimension of the American economy, accounting for $2 billion of spending--only a little less than 1% of the national output. More than 90% of the

research and development spending is for the applied type
developments with less than 10% for basic research. In a
relationship of the present technological potential to ec
Professor Slichter of Harvard has said that the rise of t
in discovery" gives business a far greater command of the
goods; that technological research increases the capacity
to raise productivity and finally, that it gives the econ
to bring about planned increases in the demand for goods,
demand for consumption goods and by creating new investme
In the water resources field there is an emerging technol
water development. There is a national desire to plan, d
operate water facilities as efficiently as science, engin
and administrative processes will permit. The national r
committees of the National Academy of Science and the Fed
of Science and Technology has instituted a study which wi
kinds of scientific and technological research needed to
support the nation's requirements for natural resources.
research and development program for FY 63 included $3.1
within-house work and $1.8 million in support of the coop
of collection and study of basic data. Technology and re
important considerations in comprehensive basin planning.
of efforts in this area should influence our judgment and
tion of the degree that research and technology will disc
of seeking out natural resources that are often considere
efficiency in productivity is bound to, in effect, create
Research and technology discovers substitutes; for exampl
of fertilizer in the production of agricultural products
been a substitute for land. More efficient treatment of
industrial products will create more water resources. Th
examples of what technology has accomplished in the past
our planning and we must keep abreast of this area in pla
use of water and services and products of water.

7. There is ample evidence of a national consensus
requires a substantial rate of economic growth. One of o
determine how water management can contribute and help st
growing economy. The needs for water regulation must be

provided will have been converted to storage for re
differently, the river regulation program will even
the flood control reservoir program insofar as the
are concerned. This highlights the fact that flood
major reservoirs will become increasingly valuable
the years, as it is converted to multiple-purpose s
regulation.

9. Efforts to inject planning for food and cr
forest products, urban area expansion, mineral deve
items into river basin planning in excess of their
on water should be resisted, as planning for these
expected to be accomplished by the going programs o
agencies. The concept of basin planning here envis
image which the TVA has sought to present since it
regional development by a river basin unit of gover

10. To carry out the broadened concepts of ba
essential step is to develop a broad economic base
reflect reasoned conclusions about the future direc
the economy of an area at selected points of time o
or so. Then we must translate the needs of this ec
and services of managed water into expressions of n
control, water supply, quality control, irrigation,
recreation and other project purposes. The idea is
accomplishment is intricate. The correlation of ec
basin and river management needs is an important un
important characteristics which will pave the way f
ments in water resources planning. This is a signi
where all the professional disciplines in the plann
comprehend interests larger than their own particul
concept for development of needs is a real challeng
have a special duty to consider what our discipline
the way of river regulation needs to stimulate econ
be able to conceive of great engineering works and
in economic jargon as to what these intensive capit
produce in terms of economic growth. This philosop

meaning with respect to the development of river regula
In providing guidance as to which economic indicators t
development in the EBS, the planners concerned with a p
project purpose should counsel with the economists in t
well in advance of consideration of projects and progra

12. Economic growth stems from activities underta
human needs. Population provides the basis for demands
uses and is generally considered to be the basic indica
all other indicators are developed in some varying degr
projections are frequently the only economic indicators
are required to estimate the needs for certain project
recreation and fish and wildlife opportunities that may
river regulations. In the Trinity study, the populatio
growth was the only one used to relate prospective comm
commodity groups representing over 250,000 tons. Perso
usually selected as an economic indicator to be develop
the principal component of the GNP and because it is th
for which data are available for use in areas smaller t
states. Personal income reflects to a high degree stan
and the economic health and wealth of an area. This in
to be related primarily to economic activities in the u
of the economy. Its use as an economic indicator is us
or averaged with a counter part population indicator wh
river regulation needs. It seems rational to relate th
indicator to establishing urban oriented flood control
municipal and industrial water supply needs. The value
facture indicator is usually selected for development i
it is a major portion of the national income and the GN
related to the urban economic sectors of society and is
the needs for municipal and industrial water supply, fl
urban areas, and to bulk commodities sent or received o
In the Trinity study the economic indicator for value a
was applied to 11 different commodity groups totalling
tons. The indicator for value of farm products sold is
agricultural activity. This indicator is generally sel
ment because it can help establish the needs and demand

principal factors which causes rapid development
economic indicator in mineral production is usual
development in the EBS for use to help establish
control and prospective commerce that might move
certain situations it may be desirable to develop
selected minerals as coal and sand and gravel or p
of oil and gas, and sometimes an indicator of a b
say those that produce energy for an area.

13. The possible indicators to assist in our
are infinite. One of the most soul-searching und
the economist and the planners under today's conc
tools, available funds and human resources is to
judgment and maintain equilibrium between costs a
This is an area of effort that requires quality a
The precise mechanism for accomplishing this assi
of the analysis and the individual responsibiliti
remain flexible because of the varying conditions
encountered across the country. As a general rul
to indicate that the EBS should not encompass the
as usually expressed in engineering terms for flo
supply, etc. There should be separate documentat
base survey and of the needs by project purposes.
this correlation is of utmost importance to the s
the stage for comprehensive basin planning. The
later on the EBS and on needs for each project pu
be more elegant, comprehensive and explicit as to
EBS and the need evaluations can work together ha

14. Seminar discussions at the evening sessi
subject paper focused on paragraph 8 with particu
concept that as the degree of river regulation in
basin the need for reserving reservoir capacity f
decreases, so that by the time substantially comp
achieved all flood control storage previously pro
converted to storage for regulation. This is the

ECONOMIC BASE SURVEYS

by
N.A. BACK, Chief Economist, Planning Divisio
Civil Works, Office of the Chief of Engineer

1. General. The purpose of the economic bas river basin planning is to provide the basis for e time the needs for and value of the goods and serv be provided by means of water resource development are directly related to the prevailing economic co the growth of the economy. The essential elements base study include an analysis of the prevailing e ditions of the area under study, including trends evaluation of the area's potential economic growth resources, people, location, climate and other ele and weakness; and projections of the major element growth.

2. Economic parameters. The elements of eco major importance in the planning of river basin pr population, households, labor force, employment, i production, and land and resources capabilities. for planning purposes are the economic aspects of of the economy directly dependent upon the service water resource developments such as, for example, using industries, waterway transportation, and flo development.

3. Prevailing conditions and past trends. T prevailing conditions and past trends is primarily of relating the status and past performance of the with that of the rest of the Nation and other area evaluating its potential for future growth. Consi this purpose are available on a county basis in th reports of the U.S. Census, Office of Business Eco

major economic parameters which produce the main economic activity from which water-related needs include population, households, labor force, emp income and production. Projections are also req sub-categories such as, heavy water using indust transportation, and flood plain development whic dependent on water resource development. In bas plans, broad regional projections broken down by or major economic areas are considered adequate. and individual project studies which involve the specific projects, projection of selected parame required for potential areas of concentrated urb use. For most planning purposes projections ove suffice. In estimating benefits and costs beyon primary reliance should be placed on reasoned ex the needs determined for the first 50 year perio

5. Refinement in economic studies. The ec should be limited to the minimum degree of detai necessary to provide a reasonably sound basis fo needs for water resource developments over time. known method of predicting future economic condi ance. Economic projections attempt to deal with through the application of reason and scientific the results can never be more than an educated a an appraisal based on reasonable assumptions and ology provides a better basis for planning than out of someone's hat. The purpose of the projec central trends and most likely values. These va approximated at best and, therefore, a high degr neither possible nor desirable and should not be

6. National and regional projections. The river basins and sub-basins, while reflecting th capacities for economic growth, should also bear relationship to the projections for the broader Nation. Reasonable conformity between the whole

Select Committee study; and the U.S. Department of Ag
projections of agricultural requirements and potentia
ferences in the projections are largely traceable to
in underlying assumptions. These projections are pre
review at the interagency level with the view to earl
on a single set of National projections for uniform a
all agencies in all river basin studies.

Much less work has been done by way of systemati
down the National projections into their regional con
although the National Planning Association has made a
in this direction. Regional economic studies and pro
an important part of the projected program of expande
studies under consideration in the Department of Comm

7. Areal significance. Descriptions and analys
economic conditions and past trends are meaningful fo
regardless of their size. They can be significant fo
regions, States, river basins, sub-basins down to and
counties and standard metropolitan statistical areas
and other economic data are compiled originally on a
metropolitan area basis. These data provide the basi
blocks for aggregating larger geographic, economic ar
areas. Recently adopted improved coding and machine
techniques by the Census Bureau should greatly facil
available data for river basins and sub-basins. Also
possible to obtain at cost from the Census Bureau spe
tions of certain unpublished economic information suc
example, industrial location and employment, so long
confidential nature of the information is protected.

For long-range economic projections the situati
different. The smaller the geographic unit, the larg
error in the projections and the less meaningful are
They have little value or significance at the county
significance increases with the size of the areas and
meaningful at the regional and National level. There

to develop other means for meeting our needs, we
in the interim to proceed largely by contracting
consultants. To what extent the Department of Co
able to meet our needs in the future is at this m
The Economics Research Service of the U.S. Depart
has been providing the economic studies and proje
agricultural sector in most basin studies. The C
as rapidly as the availability of funds and quali
permit to strengthen its economic capability and
reasonable to assume that in time it will be in a
to perform with its own forces a larger part of t
required in river basin planning. This should be
in reducing costs and in providing closer integra
economic studies and other parts of the planning

9. Requirements of Presidential Standards.
river basin studies approved by the President on
the following provision concerning economic base

"Reports on proposed plans shall include
of present and projected future economic cond
the project area and the contribution that co
project development may be expected to make t
alleviation of problems and the promotion of
growth and well-being within the zone of infl
Economic projections will be made to provide
appraisal of conditions to be expected with a
the plans under consideration, and an estimat
contribution that comprehensive development m
increased National income and welfare, and re
growth and stability. Such analyses will fre
a general economic study of the area, a study
resources, an assessment of their functional
their development potentials, possible advers
the locational situation with reference to re
markets, transportation, climate, and social
uses should indicate the significance of the

consequences of complete or partial failure to satis
needs; and (c) the possible improvements in economi
alleviation of unemployment, stabilization of produ
income, community well-being, and the quality of goo
services that will be forthcoming."

CONTRACTING FOR ECONOMIC BASE STUDIES

by
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Basin Planning Branch, North Atlantic Divisio
Corps of Engineers, New York

INTRODUCTION

1. The purpose of this paper is to present several methods that can be used in undertaking economic base and related studies for river basi project planning. Part I concerns the objective base study and shows the relationship between st appropriate method. Part II covers the preparat pectus for the study. Part III lists three meth used in making studies and provides guidelines f method to be used. The last section, Part IV, i scheduling and coordination of the economic base

PART I - OBJECTIVE OF ECONOMIC BASE STUDI

2. One of the factors governing selection economic base studies is the objective of the st basin planning studies to date, economic base st to provide a set of long- and short-term project indices of economic growth such as employment, p personal income. An economic study conceived in required to appraise present and future needs fo goods and services for a given region and its su however, is only one of the objectives of the ec A second objective, equal in importance to the p is an analysis of the economic base itself. Up have partially ignored this latter aspect and ha projections. Projections and forecasts of econo can be made without the benefit of an economic b

3. What then constitutes an economic base analy
evaluation is needed other than projections of certai
indices? The economic base of a region consists of t
ties which provide employment and income upon which t
the economic activities of the region depends. In th
the river basin region may be compared to an insular
whose livelihood is dependent on its ability to expo
services to other regions. This conception of regiona
growth has generally been referred to as "the export
Still another approach to regional economic growth is
sector theory." This theory focuses attention upon s
economic growth by studying historical shifts in regi
in terms of the concentration of the labor force in c
of the local economy. The objective of all methodolo
approaches is, however, to identify key regional acti
shed some light on dynamics of regional economic grow
cation and measurement of these key activities are of
importance to the planner since they provide an impor
the role that water resources goods and services play
to the basic activities and other non-basic or local
The importance of this type of analysis, however, can
seen by briefly reviewing still another and perhaps m
element of an economic base analysis.

4. To comprehend adequately how basic economic
operate within a region, evaluation of structural int
within the regional economy is necessary. What effec
factors have on a region's basic activities? For exa
is the net effect of a million dollar increase in inc
more of the region's basic industries? One well know
determine an estimate of this effect is through the m
process. A dollar of income to a basic industry as i
through the local economy could result in a total inc
to the region's over-all income position. Needless t
practical problems of deriving such multipliers is a
cannot be fully explored here. Indeed, as suggested
of regional analysis, there is a variety of differenc

the economic impacts of water resources developme
basin region. These impacts are manifested in a
As a general assumption in river basin studies co
projections of economic development have assumed
ploitation of natural resources to achieve projec
the determination of a plan for water resources d
in this frame of reference, provision of water re
services is considered to have a type of negative
sense that water resources development will not a
to the projected growth potential of the river ba
versely, our planning must also consider the posi
kind of impact in terms of water resources develo
a dynamic force in actually shaping the rate of f
growth. The question in the planner's mind shoul
the development of water resources induce economi
the river basin region?

6. The utility of water resource impact eva
needs examination. Would not projections of econ
alone suffice for the purposes of basin planning?
deny that projections are extremely useful in bas
preliminary concern in the past has been to provi
resource goods and services through resource deve
to provide optimum output through net benefit max
making a real contribution to regional and nation
activity. This concern will prevail in the futur
this is not the only goal for resource developmen
of impact evaluation studies is related to polici
national and local level which are increasingly c
the kinds of temporary and permanent impacts resu
resources development. The Area Redevelopment Ac
gram and the Public Works Acceleration Act embrac
to produce beneficial impacts through public work
relief of employment problems and to help create
environment attractive to business, commercial, a
enterprises in local areas. The Corps can cite a
stances where its water resources developments ha

resources development as an economic panacea in some country. Nor would quantification overcome magnific verse impacts surrounding major resources developmen regions. We do, however, have the obligation to pla public the known impacts of water resources developm hope that such information will improve the public's reach sound decisions.

8. In summary, the economic base study serves First, it provides a set of economic projections nec appraisal of water resources needs. Second, it furn an evaluation of the economic structure of the regio action of the various sectors of the regional econom these sectors are affected by factors outside the re itself. The preceding discussion emphasized the sec as the heart of the economic base study. For compre purposes, much more than projections is needed. If are desired then full economic base studies may not terms of the actual objective of the base study, our cern should be with the capabilities necessary for e the economic base and perhaps less with projections

PART II - THE BASE STUDY PROSPECTUS

9. Prior to selecting the method used for an e study, a study prospectus must be prepared. The pro necessary whether the method selected for the study by Corps-staff personnel or by a team of consultants the prospectus is a detailed outline of the base stu the following principal categories:

a. An introductory statement of the purpos all river basin study;

b. The purpose and objective of the econom

A copy of the economic base study prospectus for
Bay-Susquehanna River Basins, prepared jointly by
Health Service and the Corps of Engineers is atta
Appendix A. In this study the scope of work was
into three topics: (a) analysis of economic stru
identification and analysis of growth forces, and
of economic growth. Specific items under each of
were selected for analysis and exploration in det

11. Unfortunately, no single model base stu
applicable to all river basins. The specific obj
economic base study should reflect the problems o
river basin region. For instance, in the Susquel
about 50 percent of the population resides in are
redevelopment areas. Consequently, the base stud
specialized economic analysis of these areas. S
separate economic analysis will be made of the co
which appears to be critical in the economic dec
this region.

12. Before developing the prospectus, the
of the base study must be fairly well-defined.
two steps. First, familiarity with theoretical
economic base studies, their advantages and limi
understanding of the dynamics of regional growth
Several recent publications are very useful for
"The Community Economic Base Study" by Charles M
by the Committee for Economic Development, was w
for government officials, planners, and others c
community economic development. Using a relativ
approach, the book outlines the nature of econom
and the rudiments of economic base analysis. "R
and Economic Growth" by Perloff, Dunn, Lampard a
for Resources for the Future, Inc., presents a c
of regional economic growth patterns for the Uni
condensed and updated version of this book, enti
Grows," by Harvey Perloff is now available from

13. The second step in defining the objective a base study involves familiarization with economic act the river basin region itself. Obviously, base study cannot be defined in a vacuum and recognized realitie basin region under study must be considered. Conside compiled on a state and county basis are readily avai cation of some of the elementary tools of analysis, s the above referenced publications, will help identify and their development in recent years. Rough analysi demographic trends, for example, may be very useful i important population changes. These kinds of analyse the planner to focus his attention on critical econom and will suggest which economic activities deserve sp when the economic base study is made. As a guide to of data for this purpose, a table of selected data so attached as Appendix B.

14. While the major purpose of this second prep is to provide the basis for definition of the scope o study, the resulting analysis may be very useful in t planning stages. Our experience with economic base s shown that up to two years are usually required for c During that time other phases of basin and project pl proceed. By initially roughing out economic paramete set of a basin study, dimensions of present and futur for water resources development may be generally dete an early decision on the final direction that plannin is possible.

15. The base study prospectus can be used in a ways. It provides the outline and skeleton of the ba It is the basic working document in any discussion wi interested in undertaking such a study. It can be us for coordination with other Federal and local agencie in a basin study. As this part of the paper suggests however, should not be considered as the very first s taking the base study. Preparation of the prospectus

17. Corps-staff Method. This method concerns studies conducted within the Corps' organizational s method presupposes that Division and District office the required staff to undertake such a task. The of study would probably need at least two experienced e a trained clerical staff. The size of the staff, of vary with the complexity and breadth of the particul base study. For specialized or limited studies a si would be sufficient. The economic base study for th Hawaii was done with just such a staff. While staff may be so great that serious consideration of this m economic base study is precluded, this method posses inherent advantages. One advantage is its lower cos several alternatives. A second advantage is that th mits considerable flexibility in research work. Dur of an over-all planning study, for example, the obje base study may need modification. By use of Corps' modifications may be relatively easy. On the other a contract modifications could be costly and time co studies using this method will require a considerabl ordination with local, state, and Federal agencies i develop necessary basic data. As a general guide in studies, close contact with key local interests poss data is always useful. Local interests are also mos subject the completed base study to close scrutiny. unfortunate if the validity of a basin plan were que local interests took issue with the base study and p upon which the plan is predicated.

18. Regardless of the method employed, every l Division must be staffed with persons qualified to l the analysis of the economic base study and projecti is especially true when such a study is prepared by interests.

19. Consulting Firms. A number of economic ba underway for the Corps are being made by consulting

20. As for disadvantages, the cost of underta
study may be greater than if conducted by Corps' st
governmental agency. With the consulting firm, mod
the study after initiation may add to over-all cost
officers may be reluctant to effect such modificati
changes are desirable.

21. The above comments are necessarily genera
quality and usefulness of the completed base study
upon the type of consulting firm employed and more
on the consultant doing the work. There are basica
of consulting firms that may be available for makin
study. There is the "A-E" type consultant with an
organization generally employed in a variety of rel
contracts. Within this group there are two types o
private consulting firm and the non-profit consulti
as those associated with foundations. Which of the
"A-E's" is more desirable is less a function of the
than of staff capability.

22. A second group of consultants are those f
Here too, there are two types. One is the universi
research group; the other is the less formal organiz
university professors who undertake research projec
on a one-time basis. Despite the university aura s
type of consultant, they are not necessarily less e
the "A-E" type consultant. An advantage of the uni
sultant, however, is the ability to draw upon the r
the university. "A-E" type consultants frequently
people to perform certain portions of their study.

23. When selecting a consultant and consultin
major emphasis must be on staff capability. While
do the job, established organization, and low costs
considerations in selecting the consultant, consult
be considered unless their staff capabilities are w

25. In all likelihood, the Corps will be looking firms for a number of base studies required for river b planning. With the completion of studies now underway, in a much better position to evaluate the effectiveness consulting firms to make these studies.

26. Governmental Agencies. The Corps' initial at undertaking detailed economic base studies for the San Bay, Delaware River, and Potomac River were made by the ment of Commerce. These studies were in a sense pionee economic studies for an extended planning period. Whil studies may not have developed all the kinds of analyse jections eventually needed in the latter stages of basi they were extremely useful and valuable in the appraisa and the evaluation of benefits. The major advantage fo the base studies by the Department of Commerce was this accumulated experience and accessibility to basic econo In the Potomac study, patterned after the Delaware Rive economic base study, the Department of Commerce was abl substantial cost savings.

27. It has been suggested that to obtain uniformi all regional economic studies, a single governmental ag be made responsible. Indeed, the need for regional ecc studies extends well beyond the requirements for river planning. It has also been suggested that if all econo studies were made independently and then combined, they greater growth than that for the nation as a whole. If agency made the base study, on the other hand, it would uniformity and consistency. Furthermore, substantial r the over-all cost for the economic base study could und result.

28. Justification for vesting such a task in a si governmental agency would have to be predicated upon th of planning purposes to which the economic base study w applied. River basin planning is just one of those pur

PART IV - SCHEDULING AND COORDINATION

30. Scheduling. Previous comprehensive basi
scheduled the economic base study for completion w
two years of the comprehensive study period. Such
used to obtain the necessary economic projections
appraisals of river basin needs. However, this ea
technique has had some serious drawbacks. The maj
that when the over-all basin study is initiated an
objective of the economic study are defined, the k
analysis required of the base study are not always
This scheduling problem is most critical when the
be undertaken by a consulting firm. There would b
flexibility if the study were done by Corps' staff
that modifying the scope of the base study after c
"A-E" firm is difficult.

31. In basin planning studies requiring from
to complete, consideration should be given to sched
economic base studies up to a year after the over-
started. During the interim period, considerable
liminary economic analysis should be undertaken by
preparation for the more detailed study. Better pl
base study with other planning studies would thus
the detailed economic base study would then reflec
particular problems of the river basin region unde
projections of economic development are required e
be feasible by scheduling the economic study in a
above, consideration should then be given to develo
projections during the interim period of study. S
projections cited in Part I can be used for this p
projections would at least permit "bracketing in"
needs during initial phases of the study period.

32. If the narrower results of economic base
single sheet of projections can be avoided and the

APPENDIX A

PROSPECTUS

ECONOMIC BASE STUDY

for the

Comprehensive Water Quality Proje

of the

Department of Health, Education & W

Region III

U. S. Public Health Service

for the

Chesapeake Bay-Susquehanna River Ba

and the

Water Resources Development Stud

of the Corps of Engineers,

I. INTRODUCTION

Because of problems resulting from the dischar
of pollutants to waters of the region and the fact
are used for municipal, industrial and agricultural
for recreation, and for production of shellfish and
USPHS, DHEW has long recognized the need for a comp
quality study of the Chesapeake Bay Drainage Basin
Susquehanna River.

Under its authority for developing comprehensi
water quality management as set forth in the Federa
Control Act (P.L. 660) and Federal Water Pollution
of 1961 (P.L. 87-88), the USPHS, DHEW plans to init
water quality project for the Chesapeake Bay Draina

By resolution of the Senate Committee on Publi
of Engineers, Department of the Army, has been requ
previous reports on the Susquehanna River and tribu
view to providing a comprehensive plan for the deve
and related land resources of the Susquehanna River

These two projects will complement each other

II. PURPOSE OF THE ECONOMIC BASE STUDY

An economic base study is a prerequisite to th water resource development and water quality contro purpose is to identify and measure insofar as pract social, physical, geographical and technological fa the past, present and future economic development a basins. The study must provide the economic dimens that PHS and Corps of Engineers personnel can inter of present and future water resource goods and serv quantity requirements and quality control programs.

III. SCOPE

A. Analysis of Economic Structure

The study should include a detailed analys present economic structure of the basins and relate economy. The analysis should be developed on a sub insofar as possible, on a county basis.

Relevant information should be presented c characteristics of the area's resources and an anal and present use should be made in conjunction with

2. Population

   a. Number and growth trends

   b. Distribution by geographic region
      color (where important), income

   c. Migration - external and internal

3. Labor Force and Employment

   a. Size

   b. Employment trends

   c. Employment by major occupational
      groups

4. Personal Income

   a. Size

   b. Distribution by families and hous
      source and type of employment

   c. Analysis of trends and relationsh

5. Agriculture (This part of the study w

   a. Agricultural land base

   b. Situation and trends in relation

      (1) Farm area

      (2) Farm population

b. Rate of Marketing

c. Employment

d. Trends in development

e. Relation to associated industries

7. Manufacturing

a. Industrial establishments

number, type and location

b. Employment by industrial groups

c. Value added to product

d. Relation to area resources

Information should be given for heavy
by four-digit industrial classificati
industries are: food processing, pul
chemicals, petroleum refining, metal
generation.

8. Transportation and utilities

a. Facilities

b. Rate structure

9. Recreation and tourists

a. Facilities

b. Sports fishing

B. Identification and Analysis of Growth Forc

In detailing the structure of the basins' discussion will be presented identifying and analyzing forces which can reasonably be expected to operate effe future in fostering and sustaining economic growth. Sp will be directed to those industries of the basins whic upon the availability of water of sufficient quantity a quality. (A special study of the effects of technologi the coal mining industry of the basins will be required vances in the transportation of coal by slurries suspen may have pronounced effects in the revitalization of th industry as well as having a great effect on water need Other special studies may be necessary.)

C. Projections of Economic Growth

1. National projections

The base study will include a brief an future pattern of national economic gr purpose of relating the region to the The economic growth will be measured i terms:

a. Population

2. Basin Projections

a. Geographic areas for projections

The base study will include projec
growth of the Chesapeake Bay-Susquehanna River Basi
jections must be made by sub-drainage basins startin
hanna River Basin. Projections will also be made fo
regions, the precise definition of which will be mad
all study has been initiated. These determinations
close cooperation with both the Public Health Servic
of Engineers.

The county should be the basic buil
Groupings of counties in sub-regions should reflect
between economic considerations such as the economi
counties and the availability of comparable data, a
siderations such as hydrologic similarities and sub
areas.

b. Measures of economic development f

Projections for the basin and sub-
the following measures. In addition population pro

2. Industrial development

   a. Employment by industrial categor

      For major water using industries
      should be given by a three or fo
      industrial classification breakd
      industrial categories may be gro

   b. Product output for major water u
      where possible.

3. Agriculture (To be prepared by USDA)

   a. Farm population

   b. Livestock number

   c. Acres irrigated by crop categori

   d. Production for different types o

      cessing.

   e. Water quantities needed

4. Recreation

   a. Types of water use

   b. Some measure of amount of use by

5. Projection dates

   The projections of the above measures
   developed for the following years:

3. Analysis of Water Resource Develop

The base study will also include a analysis of the relationship of water resources dev projected economic growth. While the projections s made under the assumption of a reasonable exploitat water resources, the relative importance of water r ment to economic growth should be made explicit. I what extent would an accelerated rate of resource d the basin's projected rate of over-all economic gro

4. Methodology

The base study will include a deta of the methodology employed in the prosecution of t study. This discussion should cover the following

1. Basis for delineation of river sub-regions.

2. Availability and limitations o sources should be made explicit.

3. Statement of projection assump constraints.

IV. APPLICABLE CONSTRAINTS FOR PROJECTIONS

A. Basic Concept of Projections

A long term projection is fundamentally probable future development based on a study of past selections and application of major guiding forces an modifying conditions. Axiomatic to this concept are future conditions will probably bear some relationsh past and circumstances or limits that will modify fu can be identified, and some order among the variable activity can be identified or assumed.

B. Basic Assumptions

1. During the projection time period, experience a relatively high level of employment, a a stable general price level, average weather, and c ment and adoption of technology consistent with popu advance in the several physical sciences.

2. Probable future economic growth of the basin will require an increasingly intensive use resources.

to be made for redevelopment areas under provisions c
Redevelopment Act of 1961. Close coordination with t
development Administration should be achieved for this

4. Consistency must be maintained in t
of the projected measures. The projection for the en
should be reconciled with national growth assumption
possible.

5. The fact that short run variability
economic development should be recognized but should
for projection modification.

V. REQUIRED COORDINATION

Primary coordination will be maintained with
of the Public Health Service, Chesapeake Bay-Susqueha
Project, and with a representative of the U.S. Army E
Baltimore, Washington area Office.

Additional coordination and working relation
maintained with the Bureau of the Census, Area Redeve
istration and Office of Business Economics.

Early coordination with State and local plan

by use of a single set of selected criteria.

Separate studies of agriculture and mini
taken by the U.S. Department of Agriculture and the Bu
respectively. The contracting party will be required
with these agencies in order to incorporate the result
studies in the economic base study.

B. Basic Data Availability

PHS wishes to have access to the compile
tical data when not in use by the contractor and wants
compilations when the study is complete. The form in
is to be compiled will be determined in discussions be
tractor and the Federal agencies involved.

C. Report Timing

It is desired that the economic base stu
quehanna River Basin be completed by December 1963. I
basins will be submitted at mutually agreed upon inte
schedule for reports for the remainder of the Chesape
be worked out at a future date; howev r, at the prese
that the reports may be completed by December 1964.

APPENDIX B

ta Sources for Chesapeake and Susquehanna Basins Study
National Planning Association
Washington 9, D. C.

State	County	Urban-rural	Sources
x	x	x	a. Decennial Censuses of Population, Bureau of Census, Department of Commerce
x	x	x	b. Vital Statistics of the United States, National Office of Vital Statistics, U. S. Department of Health, Education, and Welfare
x			c. Population Redistribution and Economic Growth, U. S., 1870-1950, Simon Kuznets and D. S. Thomas, 1957
x	x	x	d. County and City Data Book, 1956, Bureau of Census, Department of Commerce
x		x	e. Regions, Resources, and Economic Growth, H. S. Perloff, E. S. Dunn, J. et al., 1960
ailed subregions ch state		x	f. Economic Areas of the United States, D. J. Bogue and C. L. Beale, 1961

ources for Chesapeake and Susquehanna Basins Study (Continued)

tate	County	Urban-rural	Sources
x	x	x	a. Decennial Censuses of Population, Bureau of Census, Department of Commerce
x	x		b. County Business Patterns, Departments of Commerce and Health, Education, and Welfare
x	x	Cities	c. County and City Data Book, Bureau of Census, Department of Commerce
x		Metro-politan Areas	d. Employment and Earnings, Bureau of Labor Statistics, Department of Labor
x		Metro-politan Areas	e. Bureau of Employment Security, Department of Labor
x			f. Unemployment Insurance Reports, Bureau of Employment Security, Department of Labor
x	x		g. Census of Agriculture, Department of Commerce, Bureau of Census
x	x	Metro-politan Areas	h. Censuses of Manufacturing, Government, Business, Mineral Industries (and Minerals Yearbook)

ces for Chesapeake and Susquehanna Basins Study (Continued)

te	County	Urban-rural	Sources
			Annual Report of Civil Aeronautics Board
			Carriers by Water, Interstate Commerce Comm.
			Railroad Employment, Interstate Commerce Comm.
x	x		a. County Business Patterns, Departments of Commerce and Health, Education, and Welfare
x	x		b. Census of Mineral Industries
x	x	Metro-politan Areas	c. Census of Manufactures
x	x		d. County and City Data Book, Bureau of Census, Department of Commerce
			e. Special listing of establishments, by county, from the census available within National Planning Association
x	x		a. Value added and shipments -- Census of Manu-

ıta Sources for Chesapeake and Susquehanna Basins Study (Continued)

State	County	Urban-rural	Sources
x			Meat production - American Meat Institute
x	x		Steel - American Iron and Steel Institute
x			a. Personal Income, by State, Office of Business Economics, Dept of Commerce b. Size-class distribution of income, Census of Population, Bureau of Census, Dept of Commerce
x			a. Industrial Water Use, 1958 Census of Manufactures, Bureau of Census, Dept of Commerce
x			a. Selected Materials Consumed, 1958 Census of Manufactures, Bureau of Census, Dept of Commerce

ROLE OF THE DEPARTMENT OF COMMERCE IN ECONOMIC

by

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of Commerce for Statistics and Economic Re

AN INTER-AGENCY PROGRAM FOR FUNDAMENTAL REGIONAL ECONOMIC RESEARCH -- A PROPOSAL

I. Need for Program

There are, in the federal establishment, at least 16 age involved in regional activity or study programs as a res operating authority. In some cases the agency is primar in identifying or anticipating the impact of a change (e of Civilian Defense Mobilization; the Office of Economic Department of Defense; and the Bureau of Public Roads), the agency is most concerned with projecting economic an variables (e.g., the investment planning programs of the the Public Health Service, Department of Interior and th Commission), in still other cases emphasis is upon impro of policy issues (e.g., the Council of Economic Advisors of the Budget). In no case does one of these agencies h really adequate information base for decision making at

There is an important reason why this is so. The funda research on the growth characteristics of regions has ne and made available in the right form. This fact stems, number of factors.

1. Economic research has been heavily biased towar growth and stability characteristics of the whole econom

2. To determine the implications of the total U.S. specific regions and sectors of the economy involves ecc an especially difficult and expensive character. Much c fundamental work requires mass data processing. The nec aggregating total experience into small areas and detail severe strains upon primary information resources. The generated within the federal establishment but are excee for the private researcher to exploit because much exist been published in public document, and because the gaps

4. At the same time the federal government has not res
to this need for several reasons.

a. Individual project limitations usually restrict th
sophistication of existing efforts. Except for the over-all po
interests of the Council and a few other agencies, the need fo
base is usually felt most directly in terms of specific region
problems. It inevitably develops that resource and time-pla
projects do not allow regional analysis to be conducted within
rich framework of the total experience of the nation and the
trasting experiences of other regions. For example, the Co
would considerably improve the quality and utility of any give
base study if its historical behavior could be interpreted in t
experience of the total U.S. economy and all other regions.
for projections to be made within the framework of discipline
effort to project for the total economy and all regions simult
intellectual and financial resources for a broader and more
for each project cannot be justified on project budgets.

b. Another major roadblock to federal action is the
that what is everyone's business in no one's business. Altho
of money are being spent each year for more limited regiona
by organizations both inside and outside the federal governm
duplication and overlapping effort takes place, no one group
support a rational total program for itself. Furthermore, i
might be genuine reluctance to undertake the expense of a to
would benefit so many.

c. Lastly, there are a number of sticky budgetary
life simpler if one does not attempt joint action. Along with
leadership and organizational problems that need to be solve

this effort it has been a focal point for a good deal of press
of agencies to expand this study substantially.

3. The Council of Economic Advisors has expressed a
seeing an inter-agency program undertaken in this area as
ment to the broader inter-agency growth study that is unde
tion.

4. It is also interesting to note that a cabinet level co
in the present administration to review Budget Bureau Circ
to the Administration's criteria for water resource investm
as a by-product of its deliberations, that some focal point f
research was badly needed and should be set up in the fede

All of these things suggest that the time is ripe to initiate s
this end.

II. A Research Program to Satisfy the Need

Regardless of whether an agency's primary concern is with
goals with a regional dimension, projecting economic and d
regionally, or measuring the regional impact of change, th
effort is required before substantial qualitative gains can b
any of these objectives. They all require a much more ade
analytical treatment of the historical growth experience of
it possible to construct a reasonably realistic projections
basis for making rational judgments about change and impa

A very fruitful beginning can be made with the tools and pri
that currently exist. The Offices of Economic Programs,
a limited program which seeks to identify, quantity and pro
analysis of the regional growth experience of the U.S. for

Much more than this is required, however. This modest beginni
expanded so that the model can incorporate demographic variable
possible, income dimensions. These analytical resource materi
backed up with a set of monographic studies, (some with an indus
and some with a regional dimension) that would bring together all
that is easily available to provide a second-order explanation of t
the observed regional growth experience. This would assist the
or policy maker using these materials to relate them to changes
and institutional structure and to changes in the region's relative
and markets. This additional effort can be undertaken immediate
expanded program.

It is desirable, as soon as possible, to build for the entire U.S.
transactions model and devise a way to wed this to the basic shift
underway. We have the techniques and data resources to build su
it would allow us to answer some of the questions concerning inte
in the absence of a complete interregional input-output model tha
to construct at the present.

Although available methodology for regional projections is the we
our conceptual framework, it is important to commence very soo
set of regional projections. This is important for two reasons.
an urgent need for this kind of information and it can feed the im
of many agencies for projections as a base for their project plan
will be especially important for such agencies as the Corps of En
Health Service, Federal Power Commission and the Department
Even with the tools already available we can generate a quantum
quality of available projection estimates. (2) As we experience t
generating defensible projections we can move more effectively t
methodology and make even more adequate projections. Further
improvements in input and method that will improve projections
time improve analytical understanding. This effort and experien

A program evolving along these lines would have two characte
would provide within a short period of time resource material
useful to the programming and planning work of a number of a
would set in motion the basic work to improve the quality and
available analytical resources so that we can look to a progre
in our regional study and activity programs and in the many pl
related to such programs.

III. Implementation of Program

In order to implement such a program it is absolutely essenti
strong staff and the necessary financial resources. A number
parties, led by the Council of Economic Advisors and the Offi
Programs, feel that it is urgent to begin this effort immediate

It is estimated that a beginning program should be planned for
least four years for a total sum of approximately $1.5 million
for the first year and about $400,000 each subsequent year).
Economic Programs, DOC, has agreed to set up a Division of
for this purpose and will contribute approximately $100,000 to
resource requirements during the first year. This is the equi
senior professionals.

In order to attract this kind of staff and produce truly new cre
work will require access to additional funds to support the cos
outlined. The indicated amount of supplementary support that
is, thus, $200,000 for the first year. We feel that it will take
make an appropriate impact for two reasons. (1) Research in
mass data processing that is tedious and expensive. Program
time must be acquired and the costs of reproducing analytical
(2) The analytical skills needed for making substantial headwa
specialized. As we seek to construct a design for research a
better analytical and projection models, we will need access

APPENDIX

Regional Growth Study, Office of Economic Programs

The general approach to this research study is bas
premise: A region or local area can be understood
its relationships to other regions and to the nati
must understand the role that the region plays in
performance of the nation, and one must know how
performance of the nation influences the performa

The technique is built upon a fundamental buildin
shifts in economic activity between regions. As
process, some regions augment while others diminis
employment (or population, income, etc.). The di
of the altered relative position is determined fo

Once the character of the growth performance for
mined as revealed by the shifts in total employme
design will seek to identify the major first-orde
differences in regional growth have occurred. At
observed shifts in employment will be divided int
components that are identified with the two major
differences in regional growth.

The two major categories of growth behavior are a

FIRST, some regions grow faster than (or fai
other regions because they specialize in the rapi
sectors of economic activity. Thus, there is a c
is based upon the "economic-mix" of the region.
that specializes in slow-growth industries will,
same, not share equally in the nation's growth.

SECOND, some regions grow more rapidly (or l
regions because they are enjoying an expansion in

The total observed shift in employment is the net effect c
these two elements -- the composition effect and the compe
Once identified, these growth components can be used to cl
into six different growth categories. Some regions have i
their share of total employment because both the compositi
shifts work in their favor. Other states have reduced the
because both the composition and competition effects work
And some areas gain from one but lose from the other, the
loss depending upon the relative strength of the compositi
petition shifts.

Beyond this the research design will allow us to identify
industry sources of the competitive gains and losses and t
industry weights associated with the composition gains and
Taken in its entirety it represents an analytical statisti
of considerable power.

In the project being planned, a computer program will be s
capacity for large numbers of regions. Beginning with emp
for the decennial years 1940, 1950 and 1960 all of the bas
will be prepared for all states, and all 3,000-plus counti
politan areas in the U.S.

An inexpensive reproduction of the data print-outs will be
able so that the large numbers of regional research groups
nation can have access to these useful source materials fo
The use of detailed county computations in this study will
the technique to be used for the first time to break out t
differences in the performance of the urban and rural regi
allow us (through reaggregation) to develop a picture of g
regions with homogeneous growth characteristics, that will
by the non-economic character of state boundaries.

ESDunn/pdf
7/10/62

APPRAISAL OF AGRICULTURAL NEEDS FOR LAND AND WA
IN RIVER BASIN PLANNING*

GENERAL SETTING

The sources of rural interest and concern in t
water and related land uses are many and varied. S
concern extend to all phases of water resource supp
control, and use that has a bearing on land use, ag
tion, the protection and conservation of resources,
of farm people.

The first impact of our annual water supply is
cipitation on the surface of the land. For the con
States, annual precipitation is 4.75 billion acre-f
the vegetative cover, slope, soil characteristics,
and conservation practices influence the extent to
becomes surface runoff, deep percolation, or soil m
transpiration. About 70 percent of the total water
evapotranspiration from vegetative watershed lands.
percent constitutes the annual water supply availab

Thus, the manner in which land in farms, range
managed has a direct impact on the potential yield
Our ability to manipulate yield is limited now but
we may improve our ability to manage land use so as
uses of water and to increase the amounts available
Land and water are interdependent resources in agri
with water management fundamentally an adjunct of l

Types of Agricultural Water Management

While the relationship of agriculture to both
uses merits consideration in comprehensive river ba
paper centers attention mainly on the agricultural
Phases of needs include water used for the producti

irrigated acreage could be doubled. Because of the hi
use of water for irrigation, agriculture accounts for
percent of the total consumption. Because of this hig
sumptive use, the economic management of water in agri
closely related to the balanced growth of all water-us
and the entire economy. Modest gains in the efficienc
water use would result in substantial increases in sup
for other uses.

Agricultural flood losses account for around one-
annual flood damages. Agricultural damages comprise a
of the total in upstream tributary areas and about 30
stream areas. Thus, agriculture has a very substantia
measures to reduce floods both upstream and downstrean

Drainage represents another aspect of water manag
to agriculture. The acreage of farmland drained is ar
acreage irrigated, and at least 80 percent of the drai
used for crop production. It has been estimated that,
20 million acres of additional cropland could be devel
drainage.

Rural people also have an interest in power, recr
quality, and other benefits from water development.

All-Sector Framework

Even though attention in this paper centers on ag
must be recognized that agricultural aspects cannot be
isolation. Rather, such aspects must be treated as ar
of an analysis of water requirements for all uses by a
the economy. The shorter the supply of water, the mor
comes the need for taking account of all competing use
of agricultural needs, as with those for any particula
represents but an initial step in approaching the prob
hensive multiple-purpose and multiple-project developm

Such a broad framework is essential for the formul
prehensive development program for a basin or a system
segment. Basin programs and systems attempt to specify
types, purposes, and development schedules of an integr
management plan for most advantageously achieving warra
Program and system plans in turn set the stage for the
detailed plans for one or more component projects. The
at this stage should be sufficient to permit authorizat
proposals designed as an integral part of the system.

A comprehensive framework plan also provides gener
for the preparation of individual project plans prepare
of an interrelated system. But it would appear difficu
in advance whether isolated projects could be formulate
components of a system. Once built, they would need to
fixed and the remainder of the system superimposed on t

Economic base studies are essential for the prepar
hensive framework plans and undertaking detailed studie
systems and projects. Such studies involve an inventor
of present and projected economic activity in the study
of the relationship of such economic activity to presen
resource supplies, and the relationships to comparable
tential development outside the region or area. The pr
of economic base studies is to provide a basis for appr
effects on economic growth and employment of different
grams and permit comparisons with various nonproject al

Resource Planning Objectives

The general objective of water resource developmen
formulation is that of designing projects, basin-wide s
grams of water control that make the greatest contribut
welfare. But such an all-embracing objective encompass
ponent elements and does not necessarily provide a sing
measure of project desirability. The gain in productiv

Certain of these objectives overlap and are not
sive. Thus, efficiency can contribute to improved li
and improved income distribution patterns. Also, the
jective may often be accommodated by using other mean
the desired distribution of maximum product. Such de
ence clauses, acreage limitations, and numerous forms
requirements may be used to influence the distributio
and services.

Even with such measures, some aspects of the dis
tive per se would need to be taken into account in pr
and selection. Such aspects as geographic distributi
maintaining balanced regional growth and accomplishin
as stabilizing individual and community income would
special consideration. The same would often hold for
vation and conservation objectives.

The treatment of multiple objectives poses some
In prevailing practice, the nonefficiency aspects are
as intangibles, with the analysis going as far as to
of their achievement in terms of efficiency sacrifice
weighting and rating devices are available for incorp
siderations in project formulation and evaluation, an
acceptable operational approach remains to be develop
need will give rise to greater efforts to provide suc

Returning to the question of appraising agricult
and water resources, the remainder of the paper is de
of national agricultural requirements, analysis of ri
and requirements, formulating a development system in
goals, and finally observations on data requirements
evaluation problems.

NATIONAL AGRICULTURAL REQUIREMENTS

Projections of Product Requirement

Projections of national requirements for agricu
should specify the quantity and mix of agricultural
and water resources probably will be required to pro
and thus establish one of the main targets toward wh
of agricultural resources should be directed. Altho
period of analysis is commonly used for project plan
period for agricultural product requirements frequen
Long-run projections are extremely sensitive to the
which the projections are derived; their principal v
indicating probable directions rather than particula

Future requirements for food and fiber products
by many variables. The size of the population at an
effect upon the amounts of agricultural products nee
The amounts of income that people have to spend and
patterns will determine the apportionment of the con
among agricultural products and among all consumptio
and composition of agricultural exports and imports,
extricably related to foreign policy, will affect fu
production requirements. The adequacy of the projec
ments for agricultural products obviously depends on
projections for the variables indicated.

Several recent studies involving projections to
furnish guidelines as to the approximate magnitudes
national agricultural production requirements. Thes
a 1980 U.S. population of 250 to 265 million people,
cent increase in per capita disposable real incomes
improvements in the average diet, and an increase of
net exports of agricultural products. The effects o
determinants combine to yield a projected increase o
above 1959 in total agricultural output needs by 198

Compared with 1959, projected crop and pasture
meet projected requirements for 1980 would each be u

Because of expected increases in productivity, i
mated that food and fiber needs in 1980 could be met
50 million fewer acres of total cropland than we curr
1962, about 63 million acres were withheld from produ
government programs of supply management and cropland
comparison with 1962 use, by 1980 cropland harvested
million acres; while cropland used for crops (which i
for crop failure and cultivated summer fallow) would
acres.

Timber and Nonagricultural Land Requireme

The projections of land requirements for crop pr
ture and range are compatible with expected requireme
nonagricultural uses, under the expectation that the
will be about the same as at present, and that an int
in forestry management. Nonagricultural uses of land
crease about one-fourth over the next two decades, wi
percent in acreages devoted to urban and recreational
in urban and other special uses would be drawn initia
use categories. Since most of these losses would be
diversions, the ultimate incidence would be on cropla

Increased multiple use of land and water resourc
of relieving certain pressures stemming from increase
ments. Multiple use is already a guiding principle c
public and private lands, particularly combinations c
with such consumptive uses as fish and wildlife and r

Projected National Water Requirements

The availability of other sources for supplying
duct requirements limits the extent to which requirem
ducts may be used directly in estimating future agric
from streamflow and ground water.

The fact that water needs must generally be met
supplies limits the value of national water use pro
regional and basin water management problems. Howev
comprehensive national estimates require careful stu
by-region basis. They can thus help identify and as
importance of regional and even local management pro
problems and aspects that warrant increased attentio
example, the appraisals of the USDA Land and Water P
the Senate Select Committee, and the more recent Res
studies all arrive at the same broad conclusions wit
U.S. water management problems: (1) Achieving more
in all areas and particularly in the West; (2) conju
of surface and ground water supplies wherever feasib
ting pollution control as an element of multipurpose
ularly to maximize recreational water values; and (4
problem of developing legal and organizational devic
management needs.

REGIONAL POTENTIALS AND RESOURCE RE

The development of an optimal system of water r
control and use requires consideration of numerous f
relationships. They include appraising the need tha
developments should be designed to serve; assessing
ect and nonproject sources of supply; and comparison
competing demands for water or use of sites within a
system or river basin program.

An analytical inventory and projection of regio
service requirements and production potentials const
starting point for analyses of the type needed. The
provide a framework of relevant information about pc
economic activity, analysis of the dependence of ecc
on resource supplies, assessments of nonproject alte
satisfying requirements, and an indication of the ex
on water development.

portion of the national production requirements. The amount
position of production from a basin is determined not only b
physical capacity to produce but also by local and national
and the basin's comparative economic advantage with other ba
of producing similar products.

River basins, therefore, cannot be treated as autonomou
planning their development. The river basins of the Nation
of the national resources which must be managed, conserved,
to satisfy the national interest. To assure consistency wit
interest, development in any basin should be geared to natio
ments and meshed with other development possibilities both w
outside the basin. Thus, an important early step in the pla
for a particular basin is to determine the types and levels
ment, and the corresponding requirements for land and water
which will best contribute to satisfying basic societal need
sistent with national potentials for fulfilling them.

Regional Allocation Methods

An allocation of the quantity and mix of agricultural p
quired from a particular region should reflect the relative
efficiency of all producing regions. Ideally, regional proj
product requirements would specify a national-regional patte
duction and distribution which would satisfy future market r
at the lowest total expenditure of economic resources (inclu
ing and transport costs as well as on-farm inputs). Some te
that may be used to assign regional requirements are: (1) e
of past and current trends; (2) judgment appraisal of potent
(3) least cost and production efficiency estimates for achie
levels of output.

Historical base and trends - This method requires the c
assembly of data concerning agricultural output of major com
regions and derivations of percentage contribution of each r
national output for a historical period. Mathematical trend

Judgment appraisal of potentials. - As in the a
mation on the current production and past trends, ex
centage of total U.S. output, is required. Establis
trends by individual commodities provides a means of
shifts in production of agricultural commodities. A
planation of these shifts provides a starting base f
tions of future national requirements. In consultat
and production specialists, consideration is given d
bility and quality of land resources in competing ar
advances in farm technology resulting from scientifi
educational and technical assistance programs, and i
managerial skill of operators. These items, plus th
experience of commodity specialists with regional pr
marketing costs, quality and kind of products produc
sumer tastes, and so on, provide a basis for apporti
allocation.

Least cost and production efficiency.- The leas
attempts to measure the relative efficiencies of pro
products from competing areas in achieving the proje
ments at minimum cost or with lowest expenditures of
Several systems of analysis are available utilizing
cal programming analysis and input-output analysis.
regional allocations are achieved within an economic
and simultaneously identify a pattern of resource us
achieve specified requirements at minimum cost. An
provides the regional allocations for a given level
efficients and could include effects of the nonagric
the economy on the agricultural sector. Such an ana
within an economic efficiency criterion. A combinat
programming and input-output analysis could provide
simultaneously take into account economic efficiency
lationships, and interregional comparative advantage

This type of systematic and objective approach
tages over the historical base, trends and judgment
advantage of such approaches is their capacity to co

Adjustments in regional allocations of national r
number of other considerations not adequately reflecte
ated methods have a bearing on the assignment of regio
national requirements. Among such considerations are:
balanced geographic dispersion of agricultural product
desired minimum farm income levels in all producing re
servation of land and water resources to meet future c
(4) avoiding drastic adjustments in existing patterns

Difficulties of quantifying many of the types of
indicated may often limit the evaluation analysis to i
cost of their accomplishment in terms of sacrifices in

Localized Agricultural Requirements

Although the bulk of agricultural products is sol
markets, significant exceptions may stem from institut
transport costs and the localization of various water-
lems. Because of institutional constraints and transp
lems, the production of such products as milk for flui
usually confined to areas readily accessible to the pa
center. Accessibility to large markets also often inf
tion of fresh vegetable production. Such cases are be
importance but require attention in evaluating the nee
water. Such considerations are inherent in the extens
obtain regional allocations. The use of a specific an
for allocation, such as linear programming, requires t
constraints be developed and applied to take account c
and other institutional factors.

Several other elements in the complex of basin an
ments for agricultural development can be considered i
national markets and product requirements. These elem
tensive study and appraisal in shaping agricultural gc
to river basin planning. Of major importance in this
adverse impacts of drought, flooding, impaired drainag

3. The contribution that resource development m
stimulating economic growth and providing employment
areas of resource underemployment.

4. Effects of agricultural use on quality, and
adequate water yield and streamflows.

The various components of need cannot be conside
and separate entities in program formulation. The ag
ducts associated with production and income stabiliza
volved in stimulating growth, may not be needed to sa
product requirements. Likewise, it may often be prod
by alternative means or in other areas. An adequate
procedure that would satisfactorily resolve and harmo
conflicts in differing objectives is yet to be develo

Nonagricultural Resource Requirements

Requirements for land and water for purposes oth
tural, both quantitatively and qualitatively, need to
along with agricultural requirements. They are impor
of any comprehensive plan of development and have a d
the appraisal of agricultural needs and supplies, and
tentials. In the design of a multifunction plan of d
scale of agricultural elements in the systems is modi
of the nonagricultural functions. Consideration of c
peting demands is required at all major stages of riv

Thus, an appraisal of nonagricultural resource r
their implications for the supply of agricultural lan
related developments as highway construction, and the
tional activity must also be ascertained. Total acre
may be estimated on the basis of population and indus
jections, trends in the study area, and experience in
with more advanced stages of economic development. T
tribution of projected economic development permits a
cation of the specific types and amounts of agricultu

and water resources. This necessitates an appraisal of and changes in cropping patterns in the interest of con efficient production, and an evaluation of increased pr might come from different types of land and water devel ing the relative costs of the different types of develo

Land Productivity Classification

A systematic classification of land is necessary t tials, including sufficient information about each clas valid inferences to be drawn concerning yield changes, patterns of use, and output and production costs.

Established physiographic regions known as "land r and a grouping of soils can be used for this purpose. areas are broad regions that have been delineated to se county into areas of similar physical features and clim ment. Within each land resource area, soil, climate, g tation, topography, and agricultural development are si

Soil groups represent combinations of "soil units" lar characteristics such as depth, texture, permeabilit presence of various soil horizons. A soil group within resource area can thus be defined as an area of land of form physical characteristics and climate considered to in suitability for agricultural use and productivity. the land resource areas, the soil groups characterize t sources of the basin and provide a practical and relati base for developing an economic evaluation of agricultu tential.

Characteristics of the Current Agricultural Economy

Data available on existing agricultural situations extensive. The main problem is that of assembling and data into forms that are significant for basin planning

of such critical operations as planting and harvestin
cant developments in the field of agricultural chemic
uted to the control of insects and diseases. Develop
analysis fertilizers and improved methods of applicat
higher rates of fertilization and higher yields.

Published and unpublished data from State and Fe
provide a basis for determining prevailing farm pract
agricultural crops. Customary tillage practices, mac
unit sizes and number of operations need to be determ
resource area. Average rates of performance are norm
termine hours of machine use and per-acre labor input
operation. These, in turn, provide a basis for deter
of producing various crops.

Production costs.- Appropriate production cost d
be developed for major commodities by land resource a
to the operating expense, estimates are needed of mac
covering all overhead items such as interest, insuran
preciation. Labor charges, seeding rates, cost of se
cides, including cost of application, also need to be

Agricultural output.- Crop production statistics
examined graphically to establish a level of producti
ing practices which would represent a normal output 1
commodity. This is done to eliminate distortions due
other regional abnormalities. Establishing "normaliz
tends to eliminate the depressing effect that earlier
lower levels of technology would have on a simple ave
acreage and yields for the various feed crops and for
are estimated by soil groups and land resource areas
current harvested acreages and yields of various crop
historical trends.

Appraisal of Production Potentials

An essential part of a basin analysis is to prov

Land-use potentials.- An appraisal of land-use po
siders the availability of land resources for future a
put. Allowances must be made for the retirement of po
from cultivation, additional land requirements for urb
growth and other nonagricultural forces operating to r
base.

Opportunities for increasing output through land-
meet indicated requirements can be achieved generally
cation of cropping systems, that is, using the land fo
of crops for which it has the greatest comparative adv
shifts in major use of land (i.e., pasture to cropland

Land development costs.- In order to appraise the
crease in production from land-use shifts, it is essen
information on conversion and production costs. Thus,
of land conversion needs to be estimated and added to
costs. Land clearing, fencing, and establishment of s
measures are the principal items included in capital r
land conversion.

Water supply.- In evaluating the adequacy of wate
meeting projected requirements, an inventory of presen
uses and available supplies by river basins is needed.
industrial demands have created supply and treatment p
localities and economic management of water in agricul
related to other water-using industries. The use of g
sources at a level much greater than the rates of rech
considered in evaluating the future availability of wa
tural uses.

The efficiency with which water is applied on the
efficiency of storage and delivery provide opportuniti
beneficial use of the available supplies. Increased f
in terms of water used per unit of product will result
research, technical assistance, and education.

achieve under assumed conditions. These assumptions
greater use will be made of technology presently kn
workers; (2) new technology will be adopted at a fa
the past; (3) present price-cost relationships of i
continue in the future; and (4) average weather wil
jected periods. The assumption that new technology
at a faster rate is based on well-established trend
of farms, a larger number of commerical units, larg
and better managed units, and more effective dissem
results.

Comparison of Requirements and Potenti

A comparison of information on projected requi
tion potentials provides bases for refining and adj
quirement estimates, appraising alternative ways of
levels of specified requirements, and assessing the
effect of water resource development. The basic pr
termining the most advantageous means of equating f
with warranted needs.

Modifications in Product Requirements

Modifications in requirements may be indicated
potentials either fall far short or greatly exceed
Such adjustments would usually require more detaile
comparisons of production potentials than were used
allocation of national requirements and would neces
sive analysis of the resource potentials of all maj
regions. Adjustments in attainable requirements wo
considering competing nonagricultural water uses an
lation to agricultural uses. Adequate consideratio
ships would usually necessitate detailed considerat
resource development proposals.

In general, modifications and adjustments in r

of alternative means of additional production for compa
ect means.

Estimates of production expected to be forthcoming
of the project would be based on projected cropping pat
tion practices, and yields. Comparisons of such estima
ed requirements would indicate the extent of any defici
project or alternative means. The analysis would proce
costs of various alternative means of meeting the indic
assess the likelihood of achieving the desired addition
such means. The costs of alternative sources of increa
provides an efficiency standard available for comparis
of the project sources for accomplishing essentially si

Water Resource Development Sources

Major sources of additional agricultural productio
source development include (1) irrigation, (2) land dra
flood protection. Irrigation provides a means by which
production may be increased substantially with a minimu
With sufficient land resources, however, economically f
tion of most crops is dependent upon low cost water and
extent to which irrigation potential is developed is de
cost of providing the water.

Drainage of agricultural land is one of the princi
which agricultural output can be increased. A substant
production increase can be brought about by the indivi
farm operators, although a considerable portion require
in providing adequate drainage outlets. Much of the pr
can be obtained on land presently cropped; thus, increa
ciency in use of factors already committed to agricultu

Increased agricultural production from flood contr
facilities can be obtained from (1) a reduction in loss
production due to flood damage, and (2) increased produ
changes in land use and more intensive management pract

The purpose of formulation analysis is to desi
programs of optimum composition and scale. The obj
lish a design for project and program development a
will maximize net benefits from the use of availabl
ect and program formulation represent the final sta
of determining the extent to which agricultural or
water can economically be satisfied. The determina
agricultural water uses in this setting necessitate
of a comprehensive intersector planning approach in
taken of all competing purposes.

Project Planning

Specifications for the proper formulation of p
lined in the Green Book and subsequently incorporat
ment No. 97. Requirements include (1) project bene
project costs; (2) benefits from each separable pur
sufficient to cover the costs of its inclusion; (3)
opment that maximizes net benefits; and (4) no more
available for accomplishing comparable purposes whi
cluded if the project were undertaken. Assembly an
types of data outlined in previous sections is esse
requirements.

Under the assumption that resources are availa
would be maximized when the scale of development ex
where benefits from the last increment equal the ad
Adjustments in scale are made to take account of in
tions.

Conditions in which resource constraints preva
modification in the approach. The benefit maximiza
applies, but within the applicable constraints. Un
tions, the scale of development is extended to a po

than attempts to array projects and make correspondir
and adjustments in the scale of particular projects r
installation.

Unless there is the expectation of continuing bu
account needs to be taken of the added cost of subsec
in scale. This cost must then be compared with the d
returns from deferred alternatives for the deferral p

Physical constraints, such as limitations on the
would give rise to similar formulation problems. If
ceeded the amount of available water, project develop
should be formulated so as to supply each of the vari
to the point where the net marginal returns were the

A similar problem is posed by the presence of in
straints such as priorities in water use, establishec
inter-State compacts governing the amount of water av
and numerous customs, sanctions, administrative regul
public controls affecting water development and use.
as rigid, the problem of economic analysis becomes th
benefits within the restraints imposed by institution
changes may lag, institutional arrangements eventuall
The economic analysis could indicate the social cost
institutional arrangements and indicate the necessity
modifications essential for achieving program objecti
of the treatment accorded institutions, the guidance
program formulated primarily on the basis of economic
warrants its preparation.

Multiple Unit and River Basin Planni

The literature on the economics of project plann
is much more extensive than that on the formulation a
multiple unit systems and river basin programs. The
such systems and programs involves both determining o

Conventional Approaches

The conventional approach to the problem of mult
calls for the establishment of an initial nucleus tha
adjusted on the basis of a series of incremental type
The initial nucleus may represent a grouping of more
purpose development potentials, a grouping of advanta
purpose projects, or a combination of the two. In an
is placed on adjusting the initial nucleus to arrive
is of appropriate composition and scale to meet desir
jectives. Adjustments are made based on: (1) The inc
clusion of specific purposes from both particular pro
program; (2) additions and omissions of projects from
(3) variation in the scale of each purpose in both si
purpose projects; and (4) comparison at various stage
means of accomplishing project purposes. The process
creasing degrees of refinement to incorporate advanta
inate least favorable) possibilities until the optimu
ulated.

Where computations are based on the use of desk
process can become rather laborious. The number of a
can be thoroughly explored is rather limited. Often
multiplicity of alternatives can be examined to assur
optimum combination of program segments. Nor is ther
the application of incremental analysis to the initia
necessarily lead to an optimal design. Where several
fering designs are feasible, the nucleus plan selecte
adjustment may not lead to the most advantageous plan
analyses are made of the major basic alternatives.

Mathematical Models

Mathematical "programming" models 1/ are a class
models well adapted to river basin planning, in that
to simultaneously accommodate and work out the effect
of resource, technological, or institutional restrict

maximization. They also provide the means for systema
ting numerous program measures and purposes, both sing
combinations. Moreover, the potential value of linear
variations of programming models has been greatly enha
computers -- permitting expansion to analyze exceeding
of alternative activities and somewhat lesser but stil
numbers of relevant restrictions.

In many respects, mathematical programming can be
extension of the trial-and-error process of the conven
starting from a project nucleus. The "programming" nu
no program-- given by all measures or project purposes
level. Each subsequent iteration (computational step)
feasible program, but with the important added feature
consistent with program objectives than any preceding
other words, the "error" aspect successively decreases

The method simultaneously considers the marginal
all possible (within the model) project additions or s
selects as the project increment that change with the
benefit. The equimarginal principle operates also, ho
marginal net benefits of all changes are zero when giv
other restrictions make further changes infeasible, or
net benefits have been realized.

A further relation of programming to conventional
evaluations is that the latter can provide the empiric
and resource-imput data on each measure to be included
ming model, screeing out those measures clearly unecon
feasible from a resource-availability or perhaps from
standpoint. Selecting formulation techniques is then
of efficiently combining benefit-cost appraisals with
appropriate to specified objectives; for example, mini
achieving given benefits or maximizing benefits result
outlays.

The type of model selected should be appropriate

however, recognize that the partial studies now purs
many facets of overall planning problems and repres
sion of labor among various specialists.

Despite their many successful applications in
of logistics and farm management, programming models
extensively employed in solving problems of resourc
or among complete river basins. The lack of suffici
and reliable information on the economic productivit
land must be noted as important reasons for this lag
may be that earlier applications were oversimplifica
ditions and relationships known to specialists inte
programming methods. If the crude models were set
representing the general method, one can understand
planners to change from procedures they considered

Under the assumption that essential basic data
searching studies of the potentialities of programmi
Harvard Water Program [2/] indicate that econometric
treat fairly complicated planning situations. Howe
completely consider sequential hydrology and other
bility distributions difficult to define. But Dorfm
that "simulation" procedures tested by the Harvard
ployed to good advantage as useful supplements to f
The idea is that repeated random sequences of hydro
example, can be run through a set (or sets) of "prog
to yield additional information on their optimum ope
specified operating rules. Consequent effects on re
other variables approximated in tentatively selecti
might then suggest certain adjustments in programs.
niques do not rest on programming models, however,
they are useful extensions of conventional formulati

Progress in the use of rapid data processing te
development of improved mathematical models should
effective tools for improving formulation practices.

Effects of System Planning on Individual Projects

The degree of justified individual project devel of a system would not necessarily be the same as that independent single-project development. The basis fo benefits in system planning becomes the added benefit of the system of each project and increment. Such ad be at least sufficient to cover the added costs of th This may be measured in terms of the difference in to benefits with and without the inclusion of the partic feature. Excess benefits from particular projects or be used to justify the costs of other projects, purpo

Where a particular project contributes significa projects in the system, the scale of development migh be greater than if the project were considered alone. potential benefits are often limited, the justified s ment will usually be less where a project is formulat of incremental benefits as a part of a system or basi

Benefits resulting from any of several segments gram would be common to the system and hence not cred segment merely because of its priority in schedule de fits from such prior development would be limited to before similar benefits were provided by other planne system. Thus, the problem of benefit allocation from would not arise. System planning would also avoid mu versy over sequence in development. The present valu in relation to costs could provide a basis for establ and early projects would not preclude later developme be justified at the time the plan was prepared as inc system.

In general, single-project development should no without benefit of system planning where economic jus on long-term deferrals of benefits or where opportuni project purposes at lower costs are evident. Single-

October 6, 1961 establishing an ad hoc Water Resourc
tions on planning procedures contained in Senate Doc
letter of November 27, 1962 from the four Secretarie
of the Bureau of the Budget outlining the substance
framework and detailed plans; and the report of the
Coordinated Water Resources Research to the Federal
and Technology, released on March 25, 1963 as a Comm
U. S. Senate Committee on Interior and Insular Affai

Adequately carrying out a program of the type p
quire both more and improved basic data and addition
studies. The information must be sufficient to prov
ing of both the problems and its framework, and offe
sidered decisions by all participating interests.

Better bases are needed for improved national a
mates of resource requirements and production potent
evaluate likely future patterns of resource use and
and regional production potentials, it is essential
data on the economic productivity of different lands
and to simultaneously consider the production possib
tire country. Improved estimates of economic produc
and analysis on physical production possibilities an
groups, on crop production costs under various level
the responses of different lands to improved technol

At the project and program formulation stage, a
are needed of relationships between and among variou
physical factors. Information must be sufficient to
sary input-output coefficients and production functi
formulation of optimal programs through either conve
or mathematical programs. Increasing stress needs t
taining information of the type that is directly sig
basin planning and project and program formulation.
sideration of the approaches to be applied and the c
data processing techniques to utilize information sh

g used for the evaluation of recreational benefits require c
rable refinement. Incorporating objectives other than effic
the analysis on a more objective basis is another continuin
meriting attention.

Questions that arise in the evaluation of underemployed res
ude the types of resources that should be encompassed, the a
s that should be made for alternative employment opportuniti
nt to which effects should be traced, whether allowances sho
or be assumed for the life of the project, the account that
aken of alternative activities providing comparable employme
rous others.

On surplus products, questions arise as to whether values a
ld be nominal, reflect export values, or reflect the influen
rnment supports. If the latter, should acreages permitted i
analysis be limited, and if so, how? Should such assumption
ne period of analysis or only to production for a specified
the remainder at the long-term projected level?

Institutions may be considered sufficiently flexible to all
num project development; or assumed to be rather rigid with
ulation made to conform. As a minimum, the analysis should
now the cost of inhibiting restraints and the benefits of mo
, including the advantages of new or alternative institutio
es, such as flood plain zoning.

Questions of the type indicated are much easier to raise th
er. They are cited as illustrative of the many remaining pr
confront us in the effort to develop and apply improved eva
planning practices.

THE APPRAISAL OF WATER NEEDS IN THE PUBLIC HEALTH SE

By James J. Flannery, Chief Economist,
Division of Water Supply & Pollution Control,
Public Health Service, Department of Health, Education a

The appraisal of water needs by the Public Health Se related directly to three water resource planning respons

1) The Water Supply Act of 1958 under the terms of Memorandum of Agreement between the Department of the Arm Department of Health, Education, and Welfare;

2) Section 2-a of the Federal Water Pollution Contr requires the development of "comprehensive programs for e or reducing the pollution of interstate waters and tribut and improving the sanitary condition of surface and under

3) Section 2-b of the Federal Water Pollution Contr requires that the Secretary of the Department of Health, and Welfare advise the Corps of Engineers and the Bureau tion or other Federal agency of the need for "inclusion c for regulations of stream flow for the purpose of water q control".

This paper describes and comments on the procedures used in the appraisal of these needs.

The appraisal procedure begins with an estimate of t levels of economic and social activity for which the wate is to be provided. Since the requests of the Corps of En the Public Health Service under the Memorandum of Agreeme to the Water Supply Act of 1958 refer generally to indivi voir projects, not to river basin systems, the estimate c is not elaborate and does not involve sophisticated metho the short time available to fulfill the request does not

The history of the area is regarded as the predomina
That is, the trends in population, employment patterns, a
whether of farm, factory, or mine are examined and record
Bureau of the Census data are usually sufficient and thei
is more marked according to the recentness of their vinta
tions as to future change are then made. These assumptio
on judgments as to the relationship of the project area t
and national expectations. These expectations are deriva
other studies, chiefly those of the National Planning Ass
Resources for the Future. The usual general assumption i
project area will participate in the changes in the natio
at a ratio not much different from the past ratio. But h
different? That question presents the difficulty, especi
agriculture has been the dominant economic activity accom
the usual rural population less. The problem is not any
mining areas affected by depletion of the resource such a
lead or decline in the market, such as coal. The hazards
sions on 50-year periods in such areas are enormous. Nei
nor devil is of help. The appraiser must acknowledge tha
he makes only a skillful guess or conjures some magic as
The strong reluctance of economists and other planners to
long range views is intensified when such small geographi
involved. No surprise or irritation should be aroused by
reluctance, for despite their present pre-eminence in nat
economists are not generally bold viewers of the future.
"dismal science" offers neither balm nor solace. Most of
strongly that forecasting is not their game. A quote fro
letter to the editor of the Washington Post by Seymour E.
Harvard University economist, is of interest in this resp

> The noneconomist expects too much from economis
> this general area. With great reluctance they
> the arena of forecasting. They prefer to call
> projections, working hypotheses, or something o
> that sort. Unfortunately, a projection or "inf
> guess" of future national income is absolutely
> sary, for without it, estimates of tax receipts

One should note that Professor Harris was ref
jections of national income and of the Gross Natio
for only a one-year period. Actually, the profess
simpler than the one confronting the single projec
The professor need not say how much of the GNP, ev
will be produced in some corner of Nebraska, Arkan
vania. He would be appalled, probably, to learn t
water resource economists indicate everyday the di
economy of some relatively obscure place and for a
50-year period! Mention of a 100-year period woul
collapse! A New York marketing firm recently boas
fearless ability to forecast the long range future
to be only five years away. This claim of power a
intended to convince the Public Health Service of
of doing business with this firm!

These comments are not intended to discourage
only to emphasize the degree of uncertainty that e
ing the economy of small areas. Elaborate studies
such small areas do not reduce the uncertainties.
is a function of the smallness of the area, as wel
period. The economy is national. Any geographic
a product of the inter-relationships between natio
or sub-regional supply and demand situations.

The necessity of establishing the future leve
the economy in small areas remains, however, no ma
is laughed at, deplored, or scorned. The new plan
tion standards expressed in Senate Document 97, 87
2nd Session, 1962, recognizes the situation and (p
requires that individual projects be related to th
developments of a comprehensive river basin plan.

Once the general dimensions of the future ecc
are established, the task of interpreting these di
of water needs begins. The Public Health Service

e development of the volume of water for future use involves a
ast an implicit assumption as to cost or requires a concurrent
amination of costs of potential sources of supply. This assum
on or examination of alternatives is necessary to assure some
cognition of willingness to pay. Though this concept does not
dicate any definite limits, it is essential as a control.

In the small areas involving individual projects, the use o
per capita figure is often sufficient as a projection base wit
porting to municipal and industrial distinctions. That is, th
ume of storage for both municipal and industrial uses is dete
ed by multiplying the population projection by a per capita
gure. This method is acceptable when the composition of the
jection base is not expected to change, and when industrial u
comparatively small. In this respect, the report should say
cifically that the volume of storage recommended covers both
nicipal and industrial uses and that because of the nature of
water-use situation, it was not feasible to establish a perc
e distribution between the two categories.

This condition points to the necessity of identifying the p
ttern of water use in a project area. An inventory of municip
s should be made, noting not only the volume of use and the p
ita figure, but also the geographic extent of the waterworks
vice area and whether there are any industrial or commercial
rs not served by the municipality. One must go beyond the
llection of these data, however, to ask why this pattern exist
what changes are likely to occur in the pattern. These ques
tain to the concept of need as distinguished from economic de

Implicit in the concept of need is a normative factor. Nee
llects a desirable condition, and some standards of public use
h as for fire protection, street cleaning, and fountains. Th
sting patterns of water use must not be regarded as the proba
dition for the future. Improvements in water quality and in
tribution system, as well as enlargement of the service areas

cost payment methods on use. Changes in the financ
and distribution of costs among users and other be
anticipated or assumed in making judgments about t
use for the future. The reports should state expli
cipations and assumptions have been made, and it is
these anticipations and assumptions to vary accord
State.

Restrictions in use may be the result of inade
poor quality, or depressed incomes, among other fac
tion must be given to the likelihood of change in t
and the effects of change on use.

The patterns of water use for industrial purpo
known than the strictly municipal categories. (Not
municipal use includes some industrial use. The Pu
Service inventories indicate that as a national ave
of water provided through municipal systems is for
poses. This national average reflects some large i
particularly in large metropolitan areas in the Eas
How much water is needed for a particular industri
large an industrial firm or how large, or what kind
complex will develop in the area? What units indic
size correlate with water use? Employment has ofte
chiefly because it is the dimension most readily es
of production are also used when feasible. The sta
ships of either of these dimensions have not been s
explored on a definitive scale. Recommendations as
industrial storage are based on a respectful look a
wet industries or large water users, judged by nati
That is, the steel industry, pulp and paper, food p
cals, refineries, and steam-electric power generati
closer regard than others. The practice has been t
volumes of water use based on national averages mod
based on experience or expectations in the region u
ular care must be exercised in developing and repor
on future volumes of use for these industrial categ

In closing the comments on this aspect of water r
one must acknowledge the necessity of better knowledge
water use and, therefore, a major research effort is r
the same as in regard to municipal use factors.

Much of the import of these remarks on the appra
needs for the purposes of the Water Supply Act of 195
the direct responsibilities of the Public Health Servi
Sections 2-a and 2-b of the Federal Water Pollution Co
Section 2-a refers to the development of comprehensive
water quality management. Section 2-b refers to the p
storage in Federal reservoirs for stream flow regulati
control. The similarity and inclusiveness of the stud
necessary to meet these two responsibilities permit th
considered together here.

Again, when individual reservoir projects are stu
usefulness for storage for stream flow regulation, the
of the location or the smallness of the area affected
almost impossible economic projection problem. No ma
near impossibility is overcome, the appraisal of stora
quality control begins with the expectations on munici
industrial water use. Waste disposal is a function la
these uses. All other water uses are also studied, bo
and instream. Furthermore, the effects on the stream
from the land must be taken into account.

The volume of storage recommended reflects consid
involving the kind and extent of waste disposal from m
and industry adjusted for treatment effects, the exte
drainage effects, the agricultural uses, and any othe
the condition of the stream including heat and color,
chemical and biological changes. These effects are j
the patterns of probable water use. The probable wat
derivative of the economic projections. The quality
the stream are intended to facilitate the water uses.
words, only that quality of water will be provided in

Another important step in the determination o
quality control storage is the identification of t
of impairment of the intended water uses that will
quality storage is not provided. This step helps
quality storage will not be recommended just as a
that storage will be related to specific water use
potential.

In this aspect of water needs determination,
several major unknowns. One is associated with th
water quality, and its control, of the return flow
Another relates to probable advances in waste trea
Research efforts are underway in both of these pro

The Public Health Service responsibility for
water quality control programs under Section 2-a o
Water Pollution Control Act provides the opportuni
rational appraisal of the water needs for quality
municipal and industrial purposes. This opportuni
because the comprehensive programs are developed f
For instance, at the present time comprehensive st
way in the Columbia, the Colorado, the Great Lakes
the Susquehanna-Chesapeake. Others will begin soo
basin approach permits the study of a major geogra
the national economy. Thus, relationships with th
national developments can be established on a more
To assure that a solid rationale will govern the a
basin economies, the PHS, in conjunction with the
in some places, has been contracting for the answe
economic dimensions. This procedure does not mean
the PHS is convinced that regional economics or ec
studies approach even comfortable certitude in the
No, the PHS recognizes that the answers are gross
and that little is known as to the contribution of
investments to economic change. The PHS has indic
efforts underway in the Department of Commerce and

The small area difficulties probably can never
Hydrology and economics are being emphasized. Ther
that the establishment of the physical volume of wa
for its measurement on the hydrologist. The assist
engineer and the economist, however, is necessary b
physical volume can be stated in terms of an econon
The relationship of quality to economic supply has
been acknowledged and is not yet fully understood.

The divergence or doubt begins. How much econ
kind of economics, and what economic and institutio
ships are involved? These bothersome and persisten
arise in all discussions. The economic demand or n
is not a determination solely of the economist, of
technological implications are the province--but no
of others. Oftentimes--because of his purist incli
economist is discontented or frustrated by what app
mythological or improper considerations. His parti
ness comes from his skills at raising questions as
both in kind and degree, and indicating the economi
consequences of various choices.

The process of decision-making in water resour
requires not only chosing among alternatives, but r
recognition that the ends are deliberately chosen a
serve those ends better than other choices. That i
ment of a river basin is not solely a matter of pro
Planning requires the establishment of objectives a
time schedule to meet them. There will be both phy
mic limitations to fulfillment. Planning means tha
attempts will be made to prevent or reduce the occu
events and deliberate attempts will be made to brin
enhance the occurrence of others, while identifying
and adjusting limitations. The choices reflect the
desires, and preferences of society, each of which
and evaluated. The questions of "what should be do

FLOOD CONTROL NEEDS

by
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1. Foreword. This paper was prepared to serv
and to generate ideas, in the collection and appra
for determination of flood control needs. It is ap
Types I, II, III, and IV basin reports. It is equa
to hurricane studies. As near as can be determine
with existing laws, procedures, and policies in ef
date.

2. Flood control needs. These are usually me
of flood damages, losses, and other effects detrime
welfare. They may be tangible, intangible, or both

3. Type of Survey. The type of survey is es
the assignment or approval of the Chief of Enginee
by the Congress or by Executive Order. Following
identification of the flood problem areas is made
screening of newspapers, public hearings, and reco
areas involved. At the present time a great amoun
is available in district offices relative to flood
and the amount of additional information required
judgement of planning personnel.

4. Pre-survey planning. As early in the stu
the SCS State Conservator(s) should be consulted r
and programs for watershed treatment in the study
to determining the effects of such programs on Cor
to reach agreement on the limits of investigations
necessary. If plans of other Federal or State age
close coordination with them is also required. It
flood damage surveys be coordinated before hand wi

5. As early as possible after initiation of stu
mation should be obtained from railroads, highway off
and pipeline companies, city officials, and others re
damages sustained in past floods to bridges, roads, u
other structures. This may be obtained by interview
or both, but letters are considered more productive.

6. Conduct of the survey. Several methods of c
flood damage surveys are employed. Three methods, in
desirability, are:

a. Detailed plot-by-plot inspection and ass
damages to lands, buildings and their contents, fence
roads and bridges, and other improvements, for one or
of flooding. Land usage, type and distribution of cr
incidence of livestock activities on rural lands are
the most costly and time consuming method and because
factors it is the least employed, except in isolated
small flood plains.

b. Detailed survey, as above, on sample are
to larger similar areas in remainder of the flood pla
less costly and time-consuming than the complete deta
and is the most employed.

c. Use of standardized tables, or curves, f
showing damages versus depth of flooding for each cla
such as residences, commercial buildings, industrial
bridges, other structures, and their contents. The c
the flood plain by classes is determined and damages
by use of the composite acre, varying by depth of flo
flood level considered. This method is adaptable to
damages to future development, but caution should be
its use for existing development. In either case, it
possible to identify the industrial and commercial ar
the flood frequency may differ from that of residenti
which the composite acre would not apply. If suffici

8. In some cases it has been found advantageou
the SCS make damage surveys on rural areas on a rei
basis. Any such agreement should specify precisely
to be covered, the data desired, and a time limit.

9. Correlation of damage-survey data. Tangib
control needs are usually expressed in terms of ave
damages, based on dollar value at a given date, pre
same date as that on which project costs are based.
most commonly used methods of computing average ann
are the damage-frequency method and that of arithme
as described below. The procedure for computing av
damages to crops differs somewhat from that for fix
ments and their contents because of the seasonal va
crop values. If it is found that the value of some
improvements vary seasonally and are significant su
contents (grain in elevators, for example), computa
those items should be by the same procedure as for
method requires correlation of damage-survey data f
in the ensuing computations.

10. Fixed improvements and their contents. A
values susceptible to stage-damage correlation with
routing reach are arrayed and summarized according
These sums are plotted to form a stage-damage curve
from zero-damage stage to the flood-limit stage ado
reach. Usually, it is necessary to plot separate c
and rural areas. If the damage values are signific
by duration of flooding or velocity of overflow, or
for those factors should be made in the applicable
stage-damage curve. Likewise, the curve should ref
iness of flooding in the reach, that is, whether or
time is sufficient for removal or replacement to hi
movable items, and the driving of livestock to high

11. Crops. By use of information obtained fr

is expected, the crop distribution should be about during the damage-survey. This criterion is based tion that the least damageable values, particularl pasture, are located in the areas most susceptible With the data thus prepared, the total damages of each increment of stage for a particular month are form a stage-damage curve for that month. Similar drawn for each month of the crop season.

12. Stage-frequency curves. The hydrologist all-year partial-duration stage-frequency curves f in the study, and monthly partial-duration stage-f for all reaches in which crops are grown.

13. Damage-frequency curves.

a. Fixed improvements and contents - By stage, the damages are plotted against all-year pa frequency, usually in percent chance of occurrence form the damage-frequency curve.

b. Crops and seasonal property - By inc the monthly damages are plotted against correspond partial-duration frequency to form the monthly dam curve. A separate curve is drawn for each month o

14. Determination of average annual damages.

a. Damage frequency method - Average an for existing conditions are the sum of the areas u frequency curves as constructed above, plus any co not adaptable to correlation by damage-frequency m

b. Method of arithmetic averages - By t assumed that floods will occur in the future in th and sequency as in the past. Generally, it yields the same results as the damage-frequency method if

c. Adjustments for future developme
damage survey indicates that space for additio
ment in the flood plain is available, and othe
ingredients for accomplishment, such as water
portation, power, and raw materials are not li
the consensus of experienced judgement indicat
development, or some parts, will take place wi
ect period of analysis, flood damage to such i
should be considered. Knowledge of any plans
ment will aid in estimating flood damages. In
of plans, an estimate of the type and location
values should be made. If this is not possibl
acres of existing types may be utilized as a b
estimating damages. Note that this procedure
on-site variables and not to regional or natio
The procedure for estimating average annual da
same as for existing development. Since the t
ment would not be in place at the start of the
ysis period, its growth during the period must
usually depicted as a growth curve. The avera
equivalent damages for future development are
mined by compound interest methods. The inter
used is the Federal rate, currently 2-7/8 perc
for straight-line growth for periods in increm
years, for 50-year and 100-year periods of ana
shown on Exhibit 2, page 251.

2 Incls:
1. Exhibit 1, page 250
2. Exhibit 2, page 251

RECREATION NEEDS

by
Lester G. Duck, Engineering Division
Corps of Engineers, Ohio River Division
Cincinnati, Ohio

Introduction. The entire water resource plann
long been subjected to the frustrations associated
us to consider outdoor recreation needs in terms of
sophical speculation that defies measurement. Now
the outset that it is essential for planning people
to the intangible values of recreation. We need to
esthetic, social, mental and physiological values d
recreation. But the concern and responsibility of
is to measure outdoor recreation needs in terms of
and facility requirements of people. Thus "needs"
process are quantitative in nature. They have to d
capacity.

Definition of Recreation Needs. Recreation ne
be simply defined as the capacity of facilities req
part of the present and future demand that is in ex
capacity of existing facilities and areas.

Basic Steps of Analysis. The determination of
involves an exercise in arithmetic rather than in p
unit of value we have used to measure this capacity
day which, so far as we can determine, submits to a
of analysis required in the formulation of water re
development. In our experience recreation needs ma
by four basic steps of analysis. This procedure wa
in the Delaware Comprehensive Report. These steps
defined below, and will be followed by detailed app
somewhat hypothetical problem.

Step 1. Determines the total demand for outdo

Step 4. Determines future needs by projecti
growth of demand from historical data obtained in

Step 5. Determines the effectiveness of the
ment and the scheduling of investments by compari
of projects contained in the plan of development
present and future needed capacities.

Discussion of Concept of Needs. Thus, the b
"needs" is a relatively simple one of demand and
of capacity. Furthermore, it is our judgment tha
requirements are best served if the concept is ke
generalized and uncluttered by the many complexit
too frequently allowed to occupy the time and eff
people. Our experience is that in many cases eff
are extremely minute in their effects and beyond
of the wider margin of estimation that quite prop
survey report scope. Furthermore, the concept is
basic procedure that must be modified and adjuste
experience to fit the localization of specific pl

Therefore, while we believe that the concept
it is applied to a project such as Lake Texoma, a
basin such as the Scioto or Delaware, or a single
of moderate impact, judgment based on experience
must be utilized in its application. For example
of a Lake Texoma might be based on national trend
and Scioto basins present problems requiring more

It should also be noted that this concept in
picnicking as a day of picnicking whether it is d
Engineers reservoir, a National Park, a National
Park, or a State hunting and fishing area, or on
bank. Needs are not for Corps of Engineers reser
for the products of visitor day units of capacity
provide.

Definition of the Problem. In the present case, based partly on fact and partly on hypothesis, we are assuming a report assignment on the Corps of Engineers for a survey-scope investigation of the Scioto River Basin in Ohio. Completion is scheduled for 1960. The problem is to determine if recreation can be justified in the plan of development on the basis of current and projected needs for recreation opportunity.

The Area of Influence. The population for which we are to measure needs for recreation is determined to be that residing in a 46-county area within a 50 mile radius of the long axis of the Scioto River system of reservoirs under study, together with the populations of the major metropolitan areas immediately adjacent. This is necessarily a judgment determination and should be made after consultation with and study by appropriate State and Federal agencies. It should be based on an examination regarding the driving habits of the people using State parks, effects of other outdoor recreation attractions, existence of any natural barriers to travel, general highway patterns and sometimes on very good traffic flow studies where they are available.

The Study Population. The population residing in the above 46-county area and adjacent metropolitan areas was recorded in the 1960 census at 4,150,000. Table 2 of the appendix (page 261) shows this population to have increased from 2,900,000 in 1940. It is expected to reach a total of 7,440,000 in the year 2000. While the composition of this population has not been considered here, it is characterized by a large and growing urban component. It might be desirable to utilize these and other characteristics in specific instances.

Determination of Recreation Demand for Base Year 1960. We have defined recreation needs as that part of demand that is in excess of the capacity of existing facilities. This definition then raises the question as to what type of investigation do we pursue to establish a measurement for this excess portion. Such a statement of the problem immediately raises questions among professional park and recreation people I have not been completely successful in laying to rest. Such people generally argue that the public wants or demands more recreation than the legislative bodies are willing to appropriate money for. So this solution to this problem generally follows a pattern of proposing a sampling of public opinion by questionnaires which asks if people want more recreation than they are getting - and invariably people do. We feel this approach yields the same statistical quality of data we would get by asking people if they want more pay and shorter hours, longer vacations with pay, earlier retirement at full pay, Cadillacs instead of Fords, or if they would rather be employed at being a star in "Gunsmoke" or at candling eggs at the supermarket.

Rather than approach the solution to the problem of demand by such method we have chosen to make what we believe to be certain logical and practical assumptions. One is that the market place for

public outdoor recreation is found in the legislative body. It is here that the tax dollar is apportioned out to buy what the people demand and that in a broad way the shares that go to highways, hospitals, schools, law enforcement, school lunch programs, and recreation are all indicative of the willingness of people from year to year to invest in these services and facilities. Accordingly we argue, that as a planning principle, the participation by people in outdoor recreation for any given year is indicative of the capacity of the general economy to support such participation. It seems to me the logic of such an assumption is substantially bolstered by the equation recreation personnel have suggested and which we have employed to project growth. This employs the three independent variables of income, leisure time and travel, which are all expressions of the economy. In line with this argrument, then, we have attempted to determine the recreation demand inherent in a population for the base year of 1960. In short, we measure this demand by the actual participation by our study population in recreation attendance at areas available to them. We agree that we haven't firmed up all aspects of consideration posed by this assumption, but we believe its concept is valid.

When we apply the mechanics of this assumption to our present case of the Scioto Basin we find that the relationship between attendance and population at the 29 public outdoor recreation areas available to the study population is 9,300,000 visits for 4,150,000 people or a visitation rate of 2.250 visits per capita. Now we have certain knowledge of this demand rate that is pertinent to its use for our purpose. We know that over any substantial period of time it is consistently increasing, and we know that the population in which it resides is also increasing. So we argue that for the base year of our, or any study, the participation as established by the trend of a series of years is statistically indicative of the demand.

It will be noted that in Step 1 of the appendix (page 259) we have reduced this demand for the population of the Scioto Basin area to units of capacity by the use of an empirical formula that is derived from a study of park attendance in the latitude of the Scioto Basin. Incidentally, we use this formula elsewhere in our work and adjust it to the available information of the locality. This formula yields the daily attendance load for a normal summer Sunday from an estimate of annual attendance. In the case of the Scioto problem, the conclusions are that the demand exerted on facilities available to the population of the study area is equivalent to the capacity required to support 265,700 people on a normal summer Sunday.

Determination of Recreation Needs. We have utilized two means of measuring that part of the total demand that is in excess of capacity for the base year. Both seek to measure the over-use of

facilities. In some cases, we have obtained estimates from parks or area superintendents as to the number of people in the total attendance at the park that are in excess of the capacity of the park. In other cases we have actually conducted field inventories with such park personnel and obtained information on numbers of parking spaces, picnic tables, linear feet of beach, number of camp sites, capacity of sanitary facilities, etc. In the present case, it will be noted in Step 2 in the appendix (page 259) that by such means it was determined that of the total annual attendance of 9,300,000, about 5% or 465,000 annual visitors were in excess to the park capacities. This determination may be approached either from the daily load estimate or from the annual attendance estimate depending upon how basic data were collected. In the present case, we have converted the estimate of annual over-use to daily load, in order that the procedure be kept consistent. Thus, for the Scioto Basin study, it will be noted that we have determined that the needs, or that part of the total demand that is in excess of capacity is equivalent to a capacity to support 13,700 people on a given day for the base year of 1960. This provides us a base upon which to build projections.

Determination of Future Needs. The Scioto study developed here is typical in that all the data required to project needs from the base year 1960 were not available for the locality. Aside from the foregoing population, attendance and capacity data, information on populations were available from 1940 through 2000, and that from several sources not entirely consistent. These data presented in Table 2, of Step 3 of the appendix (page 261) were "smoothed" graphically in the present case in order to present the technique. Generally all basic population and economic data are derived from an economic base survey where river basin reports are under way.

In any case, it is generally necessary to search for an appropriate series of data from which trends in recreation participation may be projected. In this case, park attendance records for the State of Ohio offered the most indicative data. A series of such records from 1946 through 1960 was selected as the most normal trend available following the effects of World War II. Table I of the appendix (page 260) shows the use of this series in setting up an analysis of correlation of state park attendance per capita with the three acceptable independent variables of motor vehicle miles of travel per capita, personal income per capita, and weekly hours of leisure per person employed. Thus, we were able to obtain a projected per capita rate of state park attendance for the State of Ohio from 1960 through 2000. These per capita rates of attendance provided us a basis for computing per capita rates of demand for the Scioto Basin area population. It will be noted in Table 3 of Step 3 in the appendix (page 262) that the per capita rate for the State of Ohio is 1.714 visits for state parks, while that for the Scioto Basin area is 2.250 for the base year 1960. In Table 3, it

was assumed that this proportionate relationship would maintain through the year 2000. In Table 4, we adjusted these derived rates for the Scioto Basin population graphically in order to smooth the trend and applied them against the projected Scioto Basin area population to obtain estimated annual demand in visitor days. (Table 4 is on page 262.)

Since in the final analysis we want to know the increments of capacity that will be required over the years, these increments of annual attendance were derived and are shown in Column 5 of Table 4. Table 5 of Step 3 of the appendix (page 263)reduces the increments of future annual attendance to increments of capacities that will be required to meet the projected demand. These increments have been plotted against time on Plate 1 of the appendix (page 264).

Justification. The plan of multiple-purpose development for the Scioto River consists of six small reservoir projects. The recreation plans for these six projects represent their maximum balanced development. Their combined designed capacity is sufficient to support 84,000 daily visitors. Our projection of needs shows that at the past and projected rate of growth of demand, there would be a need for the total capacity these projects provide between 1965 and 1975.

Conclusions. Now as we look at our 40 year projections, I admit they may appear frightening - they may even appear unrealistic. There are two sides to this coin however. For example, I used data from a short series of years showing extremely rapid growth in per capita rate of participation and I would suggest that if possible you develop data from the 1920's and make adjustments for the effects of World War II.

On the other hand, there is a tendency on the part of all of us to resist any idea that the population and economy is undergoing any real change. There is a tendency on the part of all of us to hang on to a belief that the last year of our existence represents a typical year. For these reasons we are not always very good students of history. And it takes very little research into the record to learn that if the changes of the next 40 years prove to be anywhere near the magnitude of the past 40, than it doesn't make much difference what we think so long as all our projections are substantially upward.

I reluctantly recall some estimates of reservoir visitation we made in the early 1940's for projects that have since been built and placed in operation. For example, I recall we estimated in the planning stage along about 1945-1946 that Fort Gibson Reservoir in Oklahoma would attract 45,000 annual visitors. In 1960 this project supported about 3,780,000 people. This is not an unusual error in estimate. I would say it is fairly typical. Yet had any one been so reckless as to have made such an estimate at that time,

we would have promptly shipped him off to a state institution. As we have stated, what we have presented is a concept or guide for determining outdoor recreation needs. It is quantitative and it provides information in terms that are consistent with the various steps of report analysis. Our experience with this method leads us to believe that it is sound. Whether, for example, the same independent variables and equation are used in setting up the technique for projection, is I believe a matter of refinement. I note that the ORRC Report uses essentially the same equation but with an added independent variable of time in years, and uses real disposable income instead of per capita of personnel income, and inter-city highway vehicle miles instead of total highway vehicle miles, which represents some refinement. The coefficient of that correlation was .98 as compared to .97 in this demonstration.

I should emphasize that we have rather hastily derived the basic values used in this paper. For example, you should carefully check the values used on the daily load formula in Step 1 against attendance characteristics in your area and even for each application. It should be added that a daily rate of turn-over on use of facilities of 1.5 to 2.0 has been used on some of our projects to convert daily load to design load of day-use type of facilities.

Now after taking up your time, I can also suggest that this matter of determining present and future recreation needs is properly, in my opinion, a responsibility of the Bureau of Outdoor Recreation. Furthermore, I suspect, that as they get organized in the field and have time to think about methods they will probably supply you with this information. But in the meantime the foregoing may provide a solution to some of your problems. In any case, it may suggest the kind of assignment you may wish to make on the BOR where you are providing funds for study.

2 Incls:
1. Appendix 1 (page 259 through 263)
2. Plate 1 (page 264)

APPENDIX I

PROBLEMS ASSOCIATED WITH DETERMINING PRESENT AND PROJECTED RECREATION NEEDS IN RIVER BASIN PLANNING

BASIC DATA AND COMPUTATIONS

STEP 1. Determination of Outdoor Recreation Demand For Base Year 1960 - Population in Zone of Influence Scioto River Basin Reservoir System - Ohio

a. Basic Data Required

(1) 1960 Attendance at 29 public recreation areas available to population residing in 46-county zone and adjacent metropolitan areas 9,300,000

(2) Formula for deriving daily attendance at recreation areas on normal summer Sunday:

$$DA = \frac{80\% \times AV}{14} \times 50\% \quad \text{or} \quad .02857 \times AV$$

DA = Daily Attendance, normal summer Sunday
AV = Estimated Annual Visitation
80% = Percent of Annual Visitation that will use facilities during normal season
14 = Number of weeks of normal season in latitude of Scioto Basin
50% = Percent of weekly visitation expected on normal summer Sunday

b. Computation of Total Demand

(1) $\frac{9,300,000 \times .80}{14} \times .50 = DA$ 265,700

STEP 2. Determination of Outdoor Recreation Needs For Base Year 1960 - Population in Zone of Influence

a. Basic Data Required

(1) Estimate of the attendance recorded for 29 public recreation areas that is in excess of capacity of the areas. Derived in some cases by estimates of percent of over-use supplied by park superintendents and in some cases by field inventory of facilities - number of parking spaces, picnic tables, etc. - over-use in annual visitation estimated at 465,000 visits.

b. Computation of Needs

(1) 9,300,000 - 465,000 = 8,835,000

$\frac{8,835,000 \times .80}{14} \times .50$ = DA of Capacity 252,000

265,700 - 252,000 = DA Equivalent of Needs 13,700

STEP 3. Determination of Future Needs For Outdoor Recreation Capacity - Population in Zone of Influence, Scioto River Basin Reservoir System - Ohio

a. Basic Data Required

(1) Tabulated Data

Table 1. Historical Basis For Projection

(1) Year	(2) Ohio Pop. (1,000's) 1/	(3) Miles Motor Vehicle Travel (1,000's) 2/	(4) State Park Attendance (1,000's) 3/	(5) State Park Visits Per Capita	(6) Personal Income Per Capita ($) 4/	(7) Motor Vehicle Miles Per Capita	(8) Weekly Hours of Leisure Per Person Employed 5/
1946	7,516	18,335,323	2,000	.2661	1,311	2,440	19.7
1947	7,705	20,027,125	3,400	.4413	1,412	2,599	20.3
1948	7,876	22,083,766	4,500	.5714	1,552	2,804	20.8
1949	7,973	23,613,042	5,754	.7217	1,472	2,962	21.2
1950	7,986	25,120,259	4,997	.6257	1,614	3,146	21.6
1951	7,962	26,830,061	6,293	.7904	1,870	3,385	21.9
1952	8,123	28,714,078	9,803	1.2068	1,958	3,535	22.0
1953	8,522	30,680,145	11,213	1.3158	2,032	3,600	22.3
1954	8,844	31,778,762	12,043	1.3617	1,957	3,593	22.7
1955	8,945	32,877,380	12,974	1.4504	2,104	3,676	22.3
1956	9,095	34,578,987	14,252	1.5670	2,236	3,802	22.4
1957	9,270	35,900,000	14,694	1.5851	2,321	3,873	23.0
1958	9,455	37,000,000	16,968	1.7946	2,206	3,913	23.0
1959	9,645	38,000,000	15,260	1.5822	2,328	3,940	23.1
1960	9,706	39,000,000	16,207	1.6698	2,340	4,018	23.1
				6/			
1965	10,704	45,000,000		1.8962	2,569	4,204	24.6
1970	11,587	51,000,000		2.1060	2,800	4,401	25.6
1975	12,470	57,300,000		2.3162	3,020	4,595	26.4
1980	13,353	66,000,000		2.6338	3,239	4,943	27.3
1985	14,205	72,750,000		2.8509	3,500	5,121	28.1
1990	15,800	79,750,000		2.8892	3,770	5,074	28.9
2000	16,922	93,750,000		3.4159	4,285	5,540	30.6

1/ 1946-1955 - From "Personal Income by States Since 1929." A supplement to the Survey of Current Business - USDC, OBE.
1959-1980 - From "Ohio Populations and Growth and Distribution, State of Ohio," Department of Industrial and Economic Development and Miami University - 1960.
1985-2000 - By extrapolation.

2/ Ohio Department of Highways.

3/ Ohio State Parks Department.

4/ From 1/ above.

5/ From ORRRC Study Report No. 26.

6/ Computed from Equation Solved in b.

Table 2. Historical and Projected Growth of Population of 46-County Zone - Scioto River Basin, Ohio

(1,000's) 1/

1940	1950	1960	1965	1970	1975	1980	1985	1990	1995	2000
2,900	3,400	4,150	4,550	4,875	5,385	5,800	6,210	6,625	7,035	7,440

1/ Basic data adjusted and "smoothed" from various sources.

b. Computations for Projected Recreation Needs

Equation: For use of data in Table 1. 1/

$$X_c\ 1.234 = a\ 1.234 + b\ 12.34X_2 + b\ 13.24X_3 + b\ 14.23X_4$$

Where:

$X_c\ 1.234$ = Estimated visits per capita

X_2 = Per capita of personal income

X_3 = Miles of motor vehicle travel per capita

X_4 = Weekly hours of leisure per person employed

$$X_1 = -1.38524 + .000453263X_2 + .000725788X_3 - .0379746X_4$$ 2/

1/ "Applied General Statistics" by Croxton and Cowden, Second Edition published by Prentice-Hall.

2/ Explained variation = 3.3928
Unexplained variation = 0.2086
Standard error of estimate = 0.1179
Coefficient of multiple determination = 0.9421
Coefficient of multiple correlation = 0.9706

Table 3. Projection of Needs

(1) Year	(2) Computed Visits Per Capita State of Ohio	(3) Actual Visits Per Capita Scioto Basin	(4) Derived Visits Per Capita Scioto
1960	1.7144	2.250	
1965	1.8962		2.484
1970	2.1060		2.768
1975	2.3162		3.035
1980	2.6338		3.452
1985	2.8509		3.736
1990	2.8892		3.786
2000	3.4159		4.477

Table 4. Projection of Needs

(1) Year	(2) Population	(3) Computed Visits Per Capita 1/	(4) Estimated Demand in Annual Visits (1,000's)	(5) Increments of Increase Annual Visits (1,000's)
1960	4,150	2.250	9,340	
1965	4,550	2.450	11,100	1,760
1970	4,875	2.720	13,300	2,200
1975	5,385	3.040	16,400	3,100
1980	5,800	3.400	19,700	3,300
1985	6,210	3.720	23,100	3,400
1990	6,625	4.000	26,500	3,400
1995	7,035	4.260	30,000	3,400
2000	7,440	4.470	33,300	3,300

1/ "Smoothed" graphically from Column 4, Table 3.

Table 5. Projection of Needs

(1) Year	(2) Increments of Increase of Demand Annual Visitation (1,000's)	(3) Increments of Increase in Daily Load Visitation 1/
1960		13,700 2/
1965	1,760	50,300
1970	2,200	62,900
1975	3,100	88,600
1980	3,300	94,300
1985	3,400	97,100
1990	3,400	97,100
1995	3,400	97,100
2000	3,300	94,300

1/ .02857 or $DL = \frac{80\% \times AV}{14} \times 50\%$

2/ Needs for base year 1960

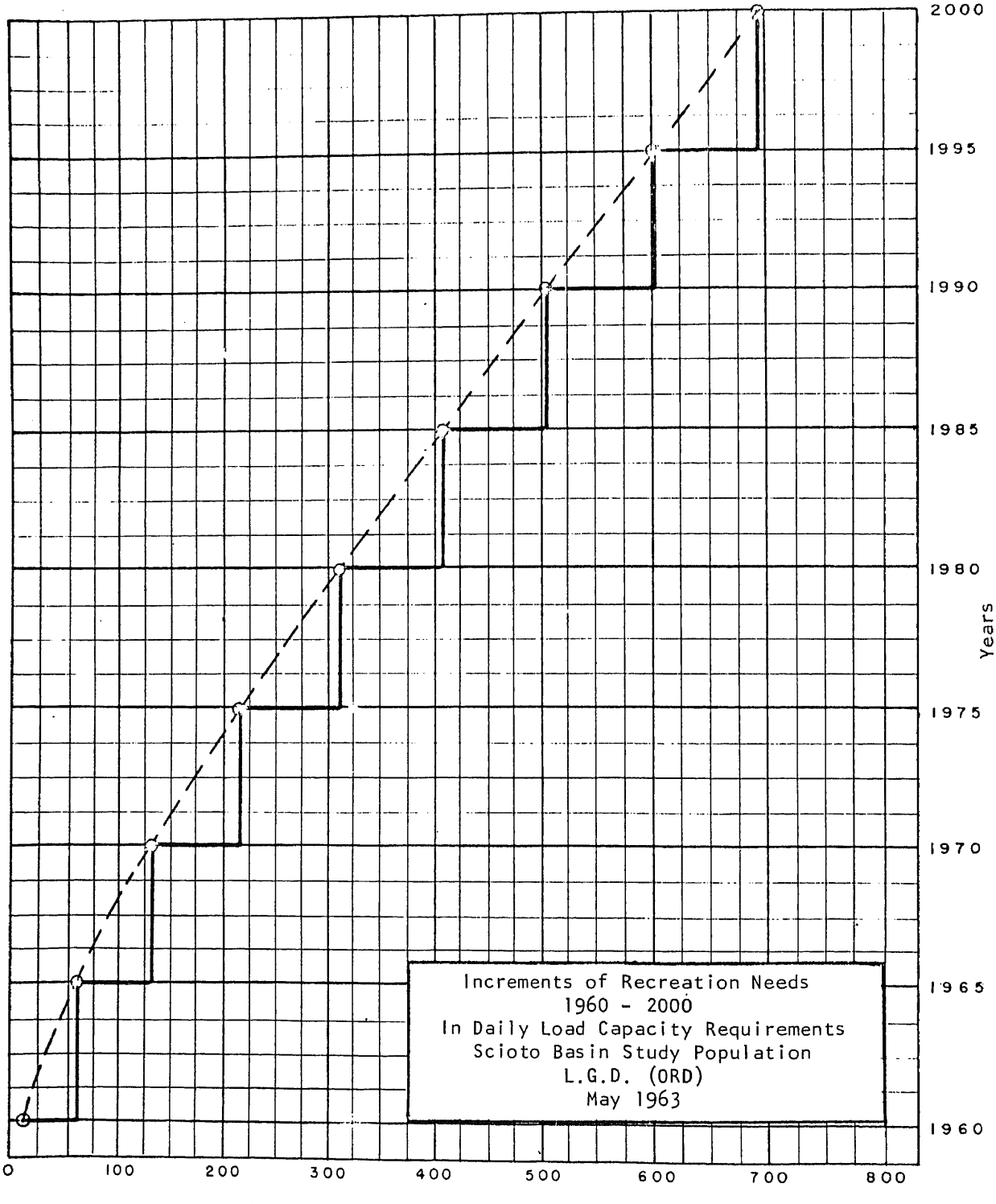
2000
1995
1990
1985
1980
1975
1970
1965
1960
Years
0
100
200
300
400
500
600
700
800
Increments of Recreation Needs
1960 - 2000
In Daily Load Capacity Requirements
Scioto Basin Study Population
L.G.D. (ORD)
May 1963
Needed Capacity in Number of Visitors
on a Normal Summer Sunday
(1,000's)

Plate I

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INTRODUCTION

The progressive development of coastal areas has had significant effect on the treatment of beach erosion problems. In formulating plans for solving beach erosion problems and/or development of coastal areas, it is now essential that a multi-purpose regional concept be utilized. This concept has long been recognized but actual implementation has been limited, due to a number of factors. Progressive modification of laws relating to responsibilities in this field of the Federal Government, and state and local governments, has provided greater latitude for implementation of this concept.

The cases are gradually increasing in number whereby improvement and/or maintenance for navigation can be effectively combined with beach erosion control measures. It is becoming increasingly important that disposal of dredged material derived from new or maintenance work in harbor and entrance channel areas be coordinated with beach stabilization measures and general coastal development. In fact, the increased requirement for recreational use of the beach zone may constitute a major percentage of the total benefits in a combined beach erosion - navigation project. This trend has had definite effect on coastal inlet planning and development.

Beach erosion control or shore stabilization is now essentially an inseparable feature of works for protecting coastal areas against hurricane damages. The public and private benefits that may be realized from reclamation of submarginal coastal lands is another important factor in hurricane protection, beach erosion control, or navigation improvement. The long range potential for development of coastal areas is much more clearly recognized now than it was several years ago. It is apparent that to derive optimum use of the coastal zone, consideration must be given to comprehensive multi-purpose planning on a regional basis. The planning, where applicable, should be an essential feature of the river basin planning.

SHORE STABILIZATION WORKS AS RELATED TO MULTI-PURPOSE USE

A coastal littoral compartment may be thought of as a reach of shore line which is not significantly affected by the littoral processes prevailing updrift or downdrift therefrom. These compartments may be extensive in length, such as are found along parts of

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the Pacific Coast, or relatively short as found along parts of the New England Coast. In developing comprehensive multi-purpose plans of improvement consideration should be given to the littoral compartment or compartments pertinent to the problem area. Geographic boundaries of political subdivisions at the coast line often define the limits of a study area, but the physiographic limits of the problem area must be considered in light of the regional aspect.

Procedures normally utilized to develope physical data for use in a multi-purpose coastal study are well established. Development and analysis of these data permit a complete historical evaluation of the problem area and evaluation of the "cause and effect relationship". These data are also used for guidance to predict future conditions at the problem site in the event improvement works are or are not constructed. Obviously, the critical part of the engineering study involves the selection of improvement works that will produce optimum results within the comprehensive plans for the entire region. This involves consideration of utilizing natural protective features of some undeveloped ocean-front areas which would exclude future habitational type development in marginal regions paralleling the shoreline and would encourage retention of those areas as park or conservation areas under public control.

The paragraphs that follow point out certain types of beach erosion control works along with limited discussion on how such works relate to multi-purpose use and/or comprehensive regional planning.

Protective Beaches - A beach of sufficient width (landward to seaward measurement) has long been recognized as one of the most efficient measures for dissipating wave energy. The beach zone landward of the mean high water line serves to dissipate wave energy under normal and moderate storm wave attack. During severe storm conditions the still water level may rise (due to storm surge) above the beach. Then storm generated waves attack whatever is located landward of this zone.

If dunes exist behind the beach, the storm waves erode the dunes and the eroded sand serves to nourish the beach zone, thereby flattening the beach slope. This in turn causes the larger storm waves to be dissipated in the beach zone or seaward thereof. After the storm waves subside, wind action tends to rebuild the dunes and dune system. It is apparent that if dunes are considered as works for protecting the upland property against wave attack associated with storms of hurricane intensity, a beach of adequate width and height must be maintained at all times in front of the dunes. If an adequate or design beach is not maintained, the effectiveness of the dune in protecting upland property may not be realized. In some cases it is not feasible to maintain a dune line or dunes of adequate dimensions for protecting upland property under severe wave attack and a sloping faced wall is substituted for or supplements the dune. The sloping faced wall should have high wave energy absorbing characteristics, thus

minimizing the seaward reflection of energy when a wave impinges on it. The effectiveness of the wall in protecting upland development is very much dependent on pre-storm condition of the beach in front of the wall. It is clear that a beach zone serves as an essential base or foundation for protective works designed to protect upland property during severe storm wave attack.

In some areas there is a paucity of suitable sand within reasonable distances which can be used for periodically replenishing the beach zone. Causes for this condition are varied, but in general, this problem is becoming progressively more acute. Utilization of materials composing the bottom in offshore zones to restore and nourish the beach zone is presently being studied. This approach has been utilized in a number of cases where the shore segment is fronted by bays, sounds, etc., however shore exposure to the open ocean present many additional problems which have not been solved for this type of beach fill operation. Proper planning and development of submarginal lands often provide not only desirable waterway systems and land enhancement but an economical source of sand supply for periodic beach nourishment. Under certain conditions an offshore breakwater (parallel to the shore) may be utilized to impound the littoral drift and the impounded drift mechanically transferred back upcoast to a feeder point. This is essentially a littoral drift re-circulating system; thus, the requirement for placing supplemental sand in the littoral stream to maintain specific beach dimensions is kept to a minimum. The sheltering effect of the offshore breakwater may also be utilized as an anchorage area for small craft. Since an offshore breakwater impounds essentially all the alongshore moving littoral drift, the problem of shore stabilization downdrift of the breakwater must also be recognized. Where updrift shores are naturally stable, sand impounded by the breakwater may be transferred or bypassed to the downdrift shores.

Beach Erosion Control at Inlets - The problem of shore stability at an inlet is primarily associated with the shore reach downdrift from the inlet, but shore stability within the inlet may also be included. The cause of the downdrift erosion is nearly always related to one or several features of the inlet whereby littoral drift is taken out of the littoral stream and either stored at the inlet or transported to deep water offshore. The drift may be partially or fully impounded by the updrift entrance jetty, the entrance channel, or the outer and inner bars associated with the inlet. The extent of downdrift shore erosion will be related to the amount of littoral drift impounded at the inlet. Sand matching this quantity and of suitable size and sorting characteristics must be placed on the downdrift shores to achieve stability for those shores. The advantages are numerous if an effective mechanical system is employed to transfer the littoral drift from the updrift side of the inlet complex to the downdrift shores. In general the sand transfer operation provides: substantial benefits to overall entrance channel stability thereby reducing maintenance, and

influencing commercial development within the harbor complex; it also provides stability to downdrift shores and if appropriate protective works are provided the degree of upland flooding during severe storm conditions would be essentially comparable to the shores updrift of the inlet, thus influencing the full potential use and development of the downdrift shores; and the bypassing of sand in this manner is in keeping with the principle of conservation of beach sand for an indefinite but lengthy period of time. In a high percentage of cases, the planning and development of inlet improvement works to achieve optimum utilization of the inlet complex is very much dependent on how effectively the problem of maintaining uninterrupted littoral transport is handled. In cases where improvement at coastal inlets benefit both the navigation and shore protection functions the cost thereof must be equitably distributed between each function.

Each inlet presents different problems and it is apparent sand transfer systems cannot be standardized. Fixed dredging plants located on or near the updrift jetty to intercept the littoral drift and hydraulically pump the material across the inlet have definite limitations. Making the plant semi-fixed such as allowing the installation to move perpendicular to the shore line on a fixed track increases the capability of this system. Namely, it increases the reservoir capacity within reach of the plant's intake mechanism and lessens the possibility for the plant to become "land-locked" during periods when the drift rate may exceed the plant's pumping capacity. One of the more effective approaches is to employ an offshore breakwater, located updrift of an entrance channel (or updrift jetty) which serves to impound the drift. The offshore breakwater serves to reduce wave action at the harbor entrance. It also serves to protect conventional floating plant from wave action during operations of transferring the impounded sand to the downdrift shores. Offshore foundation conditions, rates of alongshore drift, etc., would be typical factors for determining feasibility for utilization of this type of transfer system. Design of the updrift jetty as a shore-connected breakwater to promote littoral drift deposition in a specific area on the inner or lee side of the structure and transfer of the accumulated drift by floating plant is another system that has proven effective. Excavation and haul by land-based plant from an impounded fillet on the updrift side of the jetty is still another approach that has been applied effectively.

BEACH EROSION CONTROL AS RELATED TO RIVER BASIN PLANNING

The improvement and construction of multi-purpose works in the waterways of drainage basins tributary to a coast by their very nature, tend to enhance the general area and promote development and more effective use of the land in the basin. The combination of its overall development will reduce the quantity of sediments reaching the coast through upland river or stream discharge. This is particularly true of the sand-size class of sediments which serve to more effectively nourish the beach zone. The objective of full basin development is to achieve optimum economic use of all upland resources. The advantages from predicting effects to the coastal zone during the planning stage of basin development

are apparent. If detrimental effects will prevail, early corrective measures can be implemented at the coastal zone. Such early action will not only prevent the shore problem from reaching a critical condition but will be beneficial in the comprehensive planning and development of the contigious coastal sector. Early corrective measures will obviously have substantial beneficial effect on the economy of the coastal area.

Specific data, even if available, are difficult to evaluate relative to the effect of upland basin development on the coastal zone. It is apparent that even a qualitative evaluation is of substantial value as this contributes towards the justification for taking appropriate action at the coastal zone. Detailed criteria and techniques for the planning and design of coastal works are progressively being improved; however, such guidance leading to ultimate structural design of coastal works for specific areas has little value if realistic evaluation is not made of the past, present, and future development of the coastal zone and the areas adjacent thereto. The economic justification for constructing certain stabilizing works along a shore are frequently based on an amortization time increment of 50 years and in some cases on a 100-year basis. Therefore, present and projected upland basin development may, and generally will, be a significant factor affecting project development and functional design of improvements for a coastal problem area.

GROSS AND NET DEMANDS ON SURFACE WATERS

by
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Introduction. The appraisal of needs is unquestionably an essential step in basin planning because it defines the locations, and magnitudes of specific problems with which the planner must cope. In the case of water supply and water quality control, the next step after appraisal of needs is the translation of those needs into terms which are meaningful for design of water resource development measures. In this paper we shall examine the procedures involved in the interaction of the gross needs picture with the basin environment to identify those needs which must be served from surface sources and to express the surface needs in terms of requirements for flow augmentation at specific places in the basin stream pattern and at specific times during the course of the planning period. The flow augmentation requirements are the "net demands on surface waters" and serve as a direct basis for design of storage development. To illustrate the process we will review briefly the gross needs appraisals in the Delaware River and the Potomac River comprehensive studies, we will consider the procedures used in each of these studies to reduce gross demands to net demands on surface waters, and we shall postulate some questions which hopefully will lead to establishment of guidelines for general application to other basins in our later work group discussion.

Gross Needs and Concepts. In the Delaware Study, gross needs were projected to the year 2010 for each of eight subregions by relation of water use to the economic projections which had been made by Office of Business Economics (OBE). (See subregion map - page 279.) The subregions consisted of groupings of one or more counties whose economic activity were considered to be homogeneous. By meticulously avoiding specific local needs and distribution problems, the subregion projections provided a general guide to the water needs of relatively large economically homogeneous areas. In the Potomac River Study, however, projections were made for some 39 key needs centers, which were identified generally by major population and industrial centers. This difference in the degree of detail provided in the gross water needs appraisal necessarily gave rise to procedural differences in the process of identifying net surface water demands. In general concept, however, the two procedures are essentially parallel in that the gross demand is reduced to a net demand by consideration of the same factors.

Common Factors and Procedural Differences. Two factors common to both studies were: an appraisal of available dependable supplies both surface and ground; and an appraisal of re-use. These factors were handled somewhat differently in the two studies. In the Delaware Study the gross needs distinguished between demands by source specifying groundwater and surfacewater needs separately. (See Table P-8, page 283.) This permitted immediate elimination of the groundwater portion of the gross demand after confirmation of the availability of sufficient groundwater supplies to meet these demands. In the Potomac Study, on the other hand, the gross needs picture did not specify groundwater needs separately and the appraisal of the portion of the gross demand that could be met from the available groundwater supplies was introduced at a later stage in the analysis.

Computation of Net Surface Demands. The process of computation of the net surface water requirements in the Delaware, is illustrated on Table P-10 of the Delaware Report, Appendix P. (page 282) In this table net surface needs are developed separately for domestic and municipal use, self-supplied industrial use, and agricultural use by seven problem areas. The problem area needs configurations were derived from a rearrangement of the needs as projected for eight ecomonic subregions and for ten agricultural subbasins in order to provide a more direct correspondence of the needs areas and the basin stream pattern. (See Syllabus Map, page 280.) In general the reduction process takes account of consumptive losses within each problem area, allows for repetitive use within problem areas, and allows for availability for the 95 percent mean monthly low flow as the minimum available streamflow at each key needs reference point with appropriate adjustment for the regulatory effects of existing or proposed reservoirs.

Re-use and Consumptive Loss. In the Delaware Study re-use was considered in two ways. Water requirements to be provided for each problem area were considered to be available for re-use by downstream problem areas after suitable adjustment for consumptive loss. Also, since each problem area represented a fairly large geographical area, consideration was given to re-use within the problem area itself. In the latter case re-use factors within problem areas were worked out in coordination with Public Health Service on the basis of studies of gross industrial surface water withdrawals within each area in relation to the available flow at the appropriate downstream reference point. In the Lehigh River Problem Area, for example, the 1955 industrial withdrawals were found to be about double the available minimum flow at Bethlehem indicating a re-use of one. The re-use was projected to a magnitude of four by the year 2010. Internal re-use factors were not applied to domestic and municipal demands since the major municipally supplied population centers were located generally at the downstream end of each problem area. However, an allowance of 30 percent return from non-municipal domestic use was assumed since such use was distributed throughout the problem area.

The introduction of consumptive loss served to reduce the total effective industrial use. In the Lehigh, the re-use factor of four at year 2010 implies the original use plus four repetitions of use or a total use of five. However, after compounding a 10 percent loss with each use, taking into account that each use is less than the preceding use by the amount of the loss, the effective use, instead of 5 is found to be 4.3. Curves for equating effective use and re-use were developed for consumptive losses of 5 percent and 10 percent as shown on Plate 14 (page 284). Thus in the Lehigh problem area at year 2010, a flow of 300 cfs at Bethlehem could be regarded as sufficient to satisfy an industrial demand for 1290 cfs within the area. The unique value of this approach was that flow augmentation requirements indicated in this way inherently allowed for the consumptive losses to which they were subject in the problem area and could be translated directly to downstream areas as a contribution to the satisfaction of downstream needs. This proved to be an extremely valuable feature in subsequent project formulation because it permitted direct accumulation of flow augmentations at key flow reference points from any configuration of projects.

Procedural Differences Delaware and Potomac. In the Potomac River Study, as mentioned earlier, the gross needs appraisal did not provide water demand information by ground and surface source categories as in the case of the Delaware and instead of limiting the scope of the needs appraisal to broad economically homogeneous areas, the water projections ventured to define as many as 39 key needs centers. In addition requirements for water quality management were an essential part of the Potomac Study as in contrast with the Delaware where none were recognized. The absence of flow requirements for water quality management in the Delaware Study was predicated on analyses by Public Health Service which took into account existing and projected levels of pollution loading and the implementation of programs for secondary waste treatment. The PHS studies concluded that the flow augmentations to be provided for water supply coupled with secondary treatment would be sufficient to maintain adequate water quality throughout the basin without the need for additional flow augmentation specifically for that purpose.

(EDITOR'S NOTE: The foregoing paragraphs were presented by Mr. Mondrillo. The following paragraphs through page 276 were presented by Mr. Erickson.)

Potomac River Basin Study. In the Potomac River Basin Study the U.S. Public Health Service was the major source of the water supply and water quality control needs data. The U.S. Department of Agriculture provided data on rural domestic, agricultural, and irrigation water requirements.

Public Health Service Objectives. The objectives of the Public Health Service portion of this study was to identify all water use areas, project future water uses in these areas, relate future waste effects to stream sanitation and re-use of waters, discuss waste treatment and rates of streamflow required to meet established water quality objectives and to compute benefits that would accrue to major impoundments for low flow regulation. In order to fulfill these objectives, certain basic assumptions and considerations were made. These were determined as both reasonable and capable of attainment. First, it was considered that water for human consumption would have the highest priority of all water uses. As the supply becomes more critical and conflicts in use increase, increasing importance is placed on water quality. Second, it was assumed that within the 50-year study period, waste treatment facilities would provide up to 85 percent biochemical oxygen demand (BOD) reductions of all wastes generated.. An exception to this was the metropolitan area of Washington where 90 percent reduction was assumed. It was further assumed that such treatment should reach an efficiency of 80 percent and 85 percent by the midpoint of the planning period for the same respective portions of the basin. The projections of future water demands or needs were made in the two major categories of water supply and water quality control.

Water Supply Needs. Water supply needs were further broken down into subgroups as follows:

a. Municipal and sanitary district requirements. A municipal system was defined as that facility serving all urban and suburban populations and commerical or small industrial users located within areas of reasonable distribution. A sanitary district water system was defined as that facility which would serve unincorporated small town populations, commerical or small industrial users outside of municipal limits, and rural non-farm populations located within areas of reasonable distribution from the facility. Needs for municipal and district uses were presented by areas within the basin as governed by centers of population and potential sources of water.

b. Industrial water requirements were defined as water obtained from sources other than municipal or district supplies for use in product manufacture including in-plant processing, cooling and sanitation purposes. Projections of industrial requirements were furnished by economic subregions as in the Delaware Study and were broken down to needs for industrial needs centers which were established at areas of existing concentrated industrial development.

c. Cooling water requirements for steam-electric power generation were furnished separately. The location of these needs centers were at the same place as existing or known potential plants.

d. Rural needs. The U.S. Department of Agriculture, as part of its study of the Potomac developed projections of rural water requirements. These estimates included areas and types of uses not covered by the Public Health Service. Rural domestic water needs were furnished for the use categories of farm, rural residential and small town (beyond limits of sanitary districts). Additional rural water needs were provided for livestock use, orchard spraying and irrigation.

Water Quality Control. As a result of its study, the Public Health Service concluded that, "with present knowledge, the most practical method of maintaining stream quality after adequate treatment of wastes is by increased stream flow from stored water. No known conventional waste treatment method, by itself, exists which will provide stream conditions comparable to those obtained with conventional treatment supplemented by increased stream flow for control of dissolved oxygen, color and persistent waste substances." Consequently, gross water needs for quality control were provided in terms of total flow required at existing and potential points of concentrated discharge of treated waste effluent.

Existing Dependable Supply. In addition to the projections of gross water needs, the determination of net water demands required an inventory of existing sources of supply including estimates of quantity, quality, distribution, type and dependabilities of these supplies.

Groundwater. An inventory of groundwater resources was furnished by the U.S. Geological Survey. This study indicated those areas presently being served by groundwater, those areas in which a reasonably dependable groundwater source was present and provided estimates of yields of existing and potential sources of groundwater.

Surface Water. The water supply papers of the Geological Survey provided a source of basic data for determination of dependable stream flows. The minimum daily recorded flows on most of the basin's streams occurred in the drought of 1930, 1931 and 1932. A low-flow frequency analysis indicated that many of these minimum daily flows fell in the order of a 30-year recurrence interval. Based on this low-flow analysis, the Public Health Service in consultation with the Corps established the minimum flow regulation for water supply to be that which would meet net surface water requirements with the risk of a one to three day deficiency occurring at irregular intervals. Over a long period of time, these occurrences would average about once in 30 years.

Design Minimum Flows. The assurance of required dependable flows for all times except for a one-week period on the average of once in ten years was established as the minimum acceptance risk for quality control purposes. Using these minimum design criteria,

together with the low-flow frequency analysis of the basin streams, minimum dependable stream flows for both water supply and water quality control were established for all stream reaches and needs centers identified in the gross needs inventory. At this point, the established design minimum flows were modified for each downstream needs center to account for upstream consumptive losses resulting from irrigation use and losses through municipal, industrial, or sanitary district systems. Since irrigation demands were widely distributed throughout the basin and represented a relatively small percentage of the total basin requirements, they could be met with existing supplies. Therefore, these demands were subtracted from the design minimum flows.

Determination of Net Demands. The determination of net water needs which must be met by water resources development was performed in three stages in the Potomac Study.

a. The first stage consisted of eliminating from the total gross water needs appraisal those needs which could be met during the planning period by existing sources of supply.

b. The second stage of evaluation consisted essentially of determining the deficiency between gross needs and dependable supply. For this stage, each needs center was examined individually. The gross need may have included both a water supply and a quality control requirement or only one of the two types of needs.

In the case of a center having only a water supply need, the net demand was calculated as the difference between the gross or total requirement and the available supply. This available supply may be either groundwater or surface water and in many instances was a combination of both. It was assumed that available water would be of suitable raw water quality since this was the objective of the study. In any instance where the quality objective could not be achieved (determined in project formulation) a re-evaluation of the situation at such a needs center was necessary. For a needs center requiring only quality control, the required gross surface need was the quality control design minimum dependable flow previously established. The net demand in this case would be the deficiency between gross need and available supply. As previously indicated, quality control was considered a demand on surface supplies.

Minimum Flow Design Criteria. The majority of needs centers had a requirement for both water supply and quality control and each of these needs had a different design dependable flow. In this case with water supply having a greater priority, the net need for this purpose was determined first as the total water supply need less the water supply design dependable flow. The net quality control need was calculated as the difference between gross or total quality control

flow requirement and the water quality design dependable flow. However, since the water supply and quality control flows in a stream cannot be physically separated, the water supply design flow is mixed with the water quality design flow. Therefore, the dependable quality control minimum flow had to be reduced by the amount of the water supply dependable flow. After a few such determinations, it became evident that the total net demand for both purposes was simply the total gross demand reduced by the water quality control design dependable flow. In all cases, the net demands as calculated in this stage represent the needs which must be fulfilled by water resources development regardless of types.

Critical Flows. The final state of analysis was required for all those needs centers for which a decision had been made during the period of project formulation that net needs would be met by surface water development. This stage consisted only of determining a critical flow requirement for each stream reach or system of tributaries such that by meeting this critical flow all net demands along that reach could be satisfied through re-use of the water as it flows downstream.

(EDITOR'S NOTE: The remaining portion of this paper was presented by Mr. Mondrillo.)

It has been our intent here to present the procedures used for translating gross demands as furnished in basin-wide water needs appraisals to specific requirements for net demands on surface waters. In the course of this presentation we have drawn upon the experience of the Delaware and Potomac River Studies to highlight the problems involved. We have seen that the two methods are similar in principle but that basic differences in the scope of the water needs appraisals give rise to procedural differences in arriving at the end result. In summing up let us consider some of the differences between the two studies that raise questions as to the propriety of their use in other studies.

Groundwater. In the Delaware Study for example, groundwater projections were part of the gross needs appraisal. One may well ask whether a priori assignment of a specific portion of the gross needs to groundwater may violate the principles of project formulation by benefit maximization in that it may preclude the possible consideration of trade-offs between ground and surface water supplies as solutions to the problem in certain grey areas of overlap where either source may be economically competitive with the other. The Delaware method has merit, however, in that it clearly assigned to ground sources those needs which could not be expected to be served from surface sources. Moreover, concurrent studies showed that groundwater supplies at least in the northeastern United States are not competitive in cost with surface supplies.

Problem Area Definition. The distinction between the relatively broad economically homogeneous water problem areas of the Delaware Study and the relatively restricted needs centers of the Potomac Study deserves some consideration. In keeping to broad regional projections of water needs we respect the breadth of the economic projections on which these needs were based. In defining specific needs centers as in the Potomac, we facilitate the water budget bookkeeping which permits us to keep a close account of major withdrawals and returns in downstream succession. Should we prefer one to the other or is it possible to blend the two?

Re-use. The handling of re-use in the Delaware and Potomac Studies was similar with respect to re-use of water from one problem area or needs centers to the next. In the Potomac the nature of the needs centers did not require definition of re-use within the area. In the Delaware, however, the relatively large sizes of the problem areas required that some estimate of internal re-use within the area be made. The concept of relating minimum flow at a key downstream reference point in the problem area to the gross water withdrawals within the area is somewhat akin to the concept of relating total flood damages throughout a stream reach to flood flows at a key index station in the reach. The establishment of internal re-use factors is of necessity subject to the judgment of the planner where details of the gross withdrawals are insufficient for a precise determination. Considering the sizes of some of the economic sub-regions in some of the larger basins such as the Ohio, the propriety of application of such re-use factors may be questionable.

Base Flow Design Criteria for Water Supply. In setting the design criteria to be used as available minimum flow for water supply a decision has to be made about the degree of risk which the planner is willing to assume with regard to probability of failure to provide target levels of flow. In the Delaware Study, the design criterion was set at the 95 percent magnitude of flow taken from flow-duration curves of mean monthly flow. This implies a probable risk of failure of any single project to be able to meet its expected monthly output of water once in twenty years. On a system-wide basis the risk is one in 25 years. Not many will argue with the 95 percent risk level but many question the propriety of applying this to the mean monthly flow because of lack of assurance with respect to deficiencies of shorter duration than one month. In the Potomac on the other hand the water supply design base criterion was the 1-day 30-year flow which implied risk of failure to meet target flows for only 1-days time in a 30-year period. Is the Delaware underdesigned and the Potomac overdesigned?

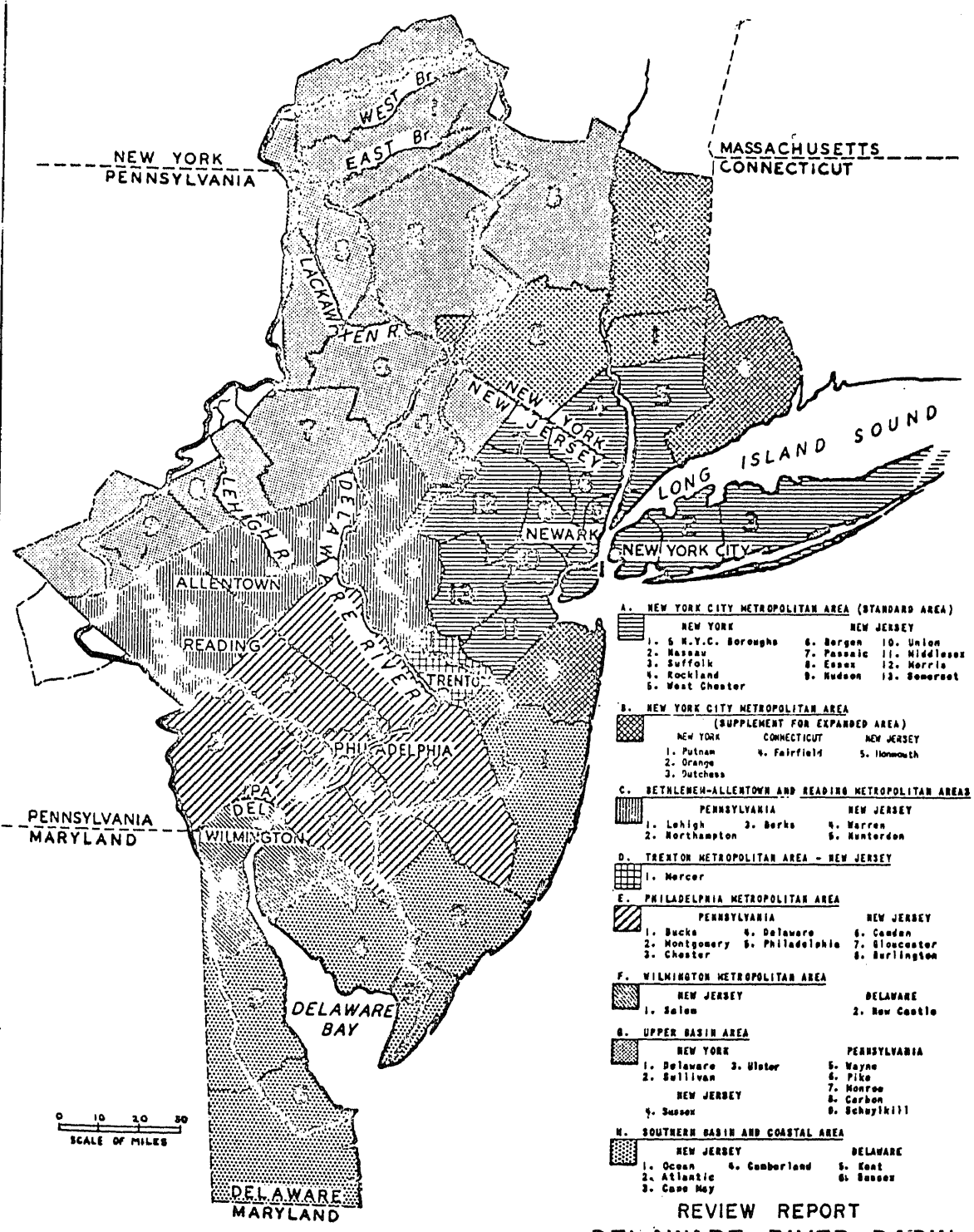
Base Flow Design Criteria for Water Quality. The flow augmentation problem in the Potomac Study was solved on a different design base for water quality than was adopted for water supply. Instead

of the 1-day 30-year flow as used for water supply, the 7-day 10-year flow was adopted. This implied willingness to accept failure more often and for a longer period than for water supply, namely one week of deficient quality once in 10 years. This criterion, established in coordination with the Public Health Service appears reasonable but presents problems of application when used in conjunction with the different criterion established for water supply. Should the two criteria be different?

Which Method? In consideration of differences in methodology in the Delaware and Potomac River Studies, indicated by the foregoing discussion, it would be fine it we had enough money and time to explore and compare a variety of different approaches so that relative orders of magnitude of differences in results could be assessed. It would also be fine if we had some rules to follow so that we would not be plagued by decisions concerning choice of methodology. It is fairly certain, however, that no single method can be said to be best for all basins and the adopted procedures in any individual study will depend largely on the nature of the area, its location, its relative availability of ground and surface waters, the nature of the water needs, the economic development, land use, and other related variables. Therefore, any standards which are developed as guidelines for pursuit of water demand studies must necessarily be sufficiently flexible to permit the exercise of judgment while assuring a reasonable degree of uniformity and comparability throughout the country.

Inclosures through page 290.

CORPS OF ENGINEERS U.S. ARMY



Delaware River Basin Boundary

A. NEW YORK CITY METROPOLITAN AREA (STANDARD AREA)

NEW YORK	NEW JERSEY
1. 5 N.Y.C. Boroughs	6. Bergen
2. Nassau	7. Passaic
3. Suffolk	8. Essex
4. Rockland	9. Hudson
5. West Chester	10. Union
	11. Middlesex
	12. Morris
	13. Somerset

B. NEW YORK CITY METROPOLITAN AREA
(SUPPLEMENT FOR EXPANDED AREA)

NEW YORK	CONNECTICUT	NEW JERSEY
1. Putnam	4. Fairfield	5. Monmouth
2. Orange		
3. Dutchess		

C. BETHLEHEM-ALLENTOWN AND READING METROPOLITAN AREAS

PENNSYLVANIA		NEW JERSEY
1. Lehigh	3. Berks	4. Warren
2. Northampton		5. Hunterdon

D. TRENTON METROPOLITAN AREA - NEW JERSEY
1. Mercer

E. PHILADELPHIA METROPOLITAN AREA

PENNSYLVANIA		NEW JERSEY
1. Bucks	4. Delaware	6. Camden
2. Montgomery	5. Philadelphia	7. Gloucester
3. Chester		8. Burlington

F. WILMINGTON METROPOLITAN AREA

NEW JERSEY	DELAWARE
1. Salem	2. New Castle

G. UPPER BASIN AREA

NEW YORK		PENNSYLVANIA
1. Delaware	3. Ulster	5. Wayne
2. Sullivan		6. Pike
		7. Monroe
NEW JERSEY		8. Carbon
4. Sussex		9. Schuylkill

H. SOUTHERN BASIN AND COASTAL AREA

NEW JERSEY		DELAWARE
1. Ocean	4. Cumberland	5. Kent
2. Atlantic		6. Sussex
3. Cape May		

REVIEW REPORT
DELAWARE RIVER BASIN
ECONOMIC SUB - REGIONS

In 1 Sheet
Corps of Engineers
Philadelphia, Pa.

Scale as Shown
Philadelphia District
23 Oct. 1959

UPPER DELAWARE

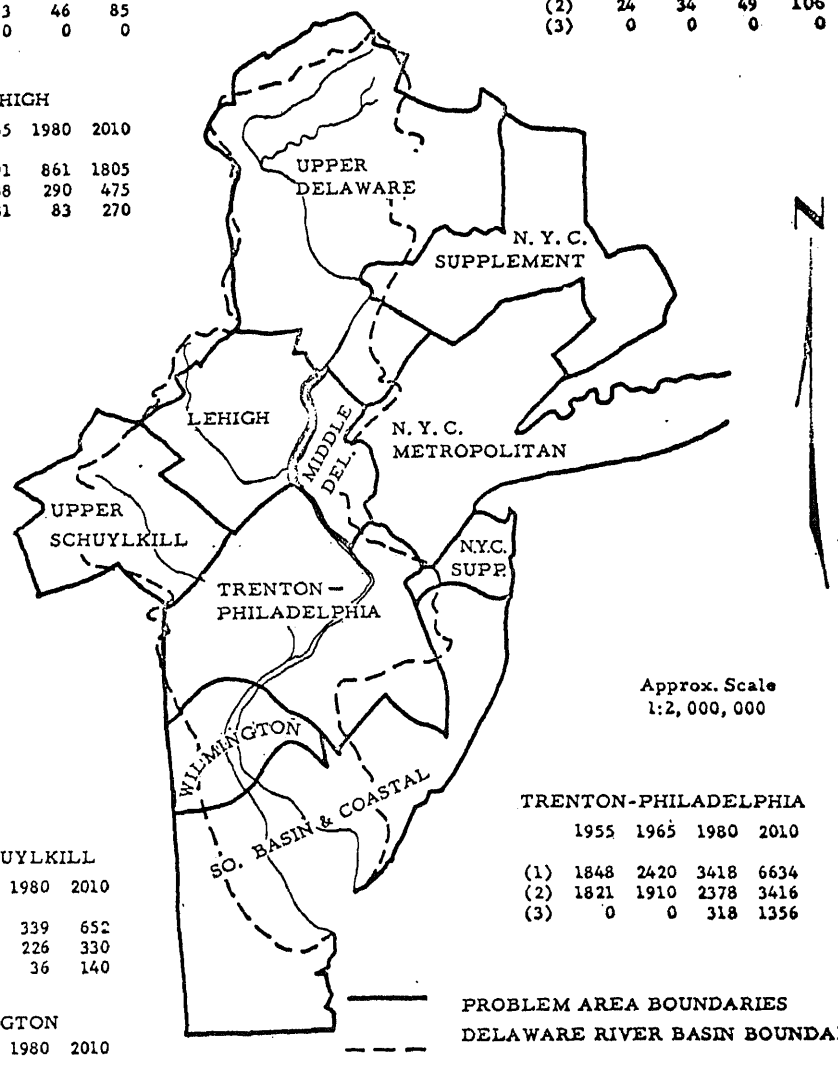
	1955	1965	1980	2010
(1)	40	54	74	128
(2)	21	33	46	85
(3)	0	0	0	0

LEHIGH

	1955	1965	1980	2010
(1)	430	591	861	1805
(2)	206	238	290	475
(3)	0	31	83	270

MIDDLE DELAWARE

	1955	1965	1980	2010
(1)	43	58	80	156
(2)	24	34	49	106
(3)	0	0	0	0



Approx. Scale
1:2, 000, 000

UPPER SCHUYLKILL

	1955	1965	1980	2010
(1)	168	238	339	652
(2)	121	176	226	330
(3)	0	0	36	140

WILMINGTON

	1955	1965	1980	2010
(1)	271	1085	1771	3113
(2)	240	993	1636	2910
(3)	0	0	25	340

SO. BASIN & COASTAL

	1955	1965	1980	2010
(1)	86	165	257	494
(2)	13	20	26	42
(3)	0	0	0	0

TRENTON-PHILADELPHIA

	1955	1965	1980	2010
(1)	1848	2420	3418	6634
(2)	1821	1910	2378	3416
(3)	0	0	318	1356

PROBLEM AREA BOUNDARIES

DELAWARE RIVER BASIN BOUNDARY

LEGEND:

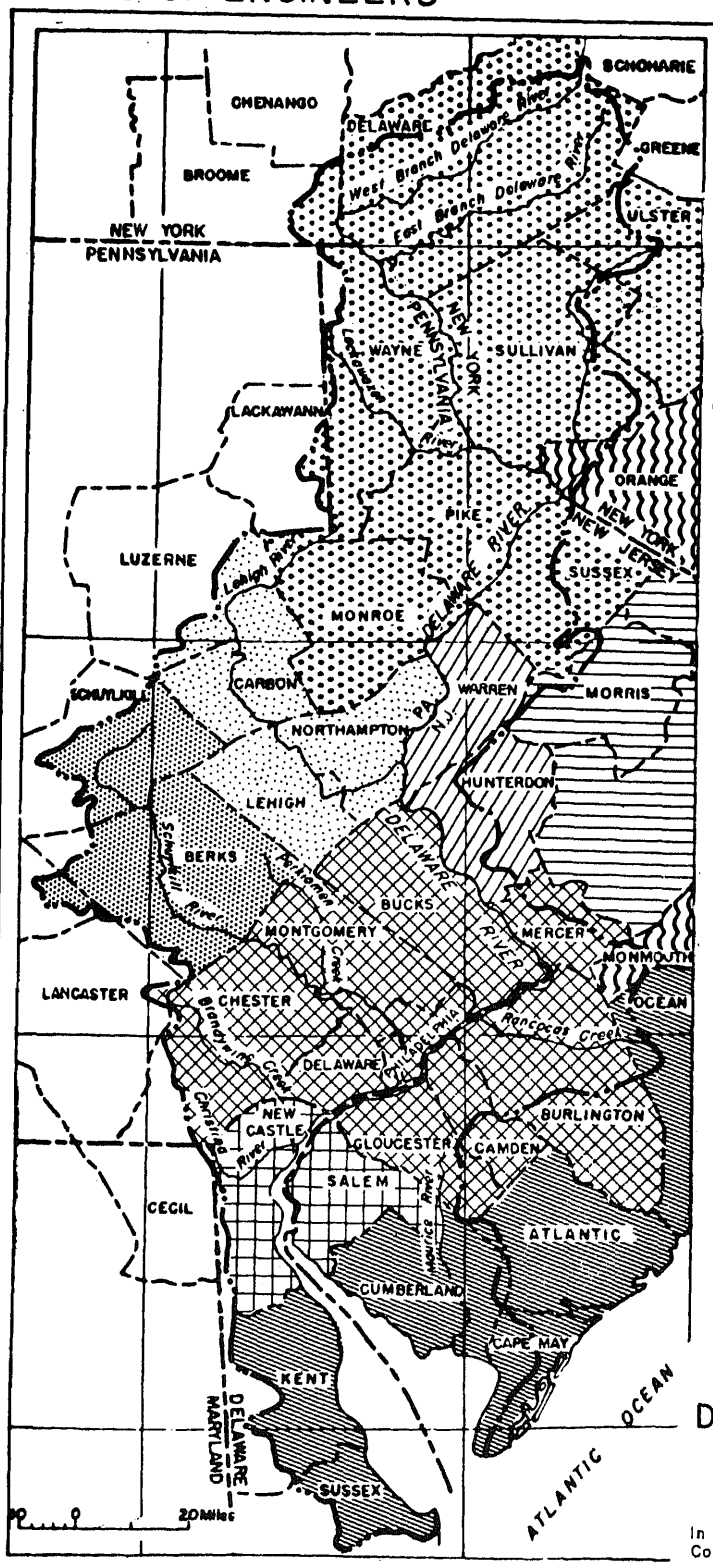
(1) GROSS WATER NEEDS
(2) NET SURFACE NEEDS.
(3) REQUIRED FLOW AUGMENTATION

All quantities in million gallons per day.

GROSS AND NET WATER NEEDS IN PROBLEM AREAS OF THE DELAWARE RIVER BASIN

CORPS OF ENGINEERS

U.S. ARMY



Water Problem Area

- N.Y.C. Metropolitan
- N.Y.C. Supplement
- So. Basin & Coastal
- Upper Delaware
- Middle Delaware
- Lehigh
- Upper Schuylkill
- Trenton · Phila.
- Wilmington

REVIEW REPORT

DELAWARE RIVER BASIN

WATER PROBLEM AREAS

In 1 Sheet
Corps of Engineers
Philadelphia, Pa.

Drawer No. 228

Scale as Shown
Philadelphia District
23 Oct. 1959

File No. 29079

	UPPER DELAWARE				MIDDLE DELAWARE			
	1955	1965	1980	2010	1955	1965	1980	2010
DOMESTIC AND MUNICIPAL[1/]								
(1) Gross Surface	13.9	20.0	27.6	49.0	4.5	6.0	8.3	15.4
(2) Gross Ground	4.0	4.4	5.9	10.0	3.9	4.9	6.5	10.7
(3) Other	8.2	9.1	12.1	20.4	4.1	4.9	6.7	11.0
(4) Return from "other"	2.5	2.7	3.6	6.1	1.2	1.5	2.0	3.3
(5) Net surface need (1) - (4)	11.4	17.3	24.0	42.9	3.3	4.5	6.3	12.1
SELF SUPPLIED INDUSTRIAL[1/]								
(6) Gross Surface	8.0	12.3	18.3	38.3	21.0	29.1	43.1	94.2
(7) Gross Ground	1.0	1.4	1.8	3.0	10.0	12.8	16.2	24.5
(8) Consumptive loss, L, %	5.0	5.0	5.0	5.0	10.0	10.0	10.0	10.0
(9) Re-use	0	0	0	0	0	0	0	0
(10) Effective use [2/]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
(11) Net surface need (6) / (10)	8.0	12.3	18.3	38.3	21.0	29.1	43.1	94.2
AGRICULTURAL[1/]								
(12) Net[3/]	1.4	3.3	3.9	4.0	Incl. in Trenton-Phila.			
NET SURFACE NEEDS ALL USES								
(13) (5) + (11) + (12)	20.8	32.9	46.2	85.2	24.3	33.6	49.4	106.3
(14) Upstream surface loss[4/]								
(15) Net adj. for upstream loss	20.8	32.9	46.2	85.2	24.3	33.6	49.4	106.3
AUGMENTATION REQUIREMENTS[5/]								
(16) Minimum surface flow[6/]	*	*	*	*	*	*	*	*
(17) Augmentation req.(15)-(16)	0	0	0	0	0	0	0	0

1/ Gross water needs from Table P-8

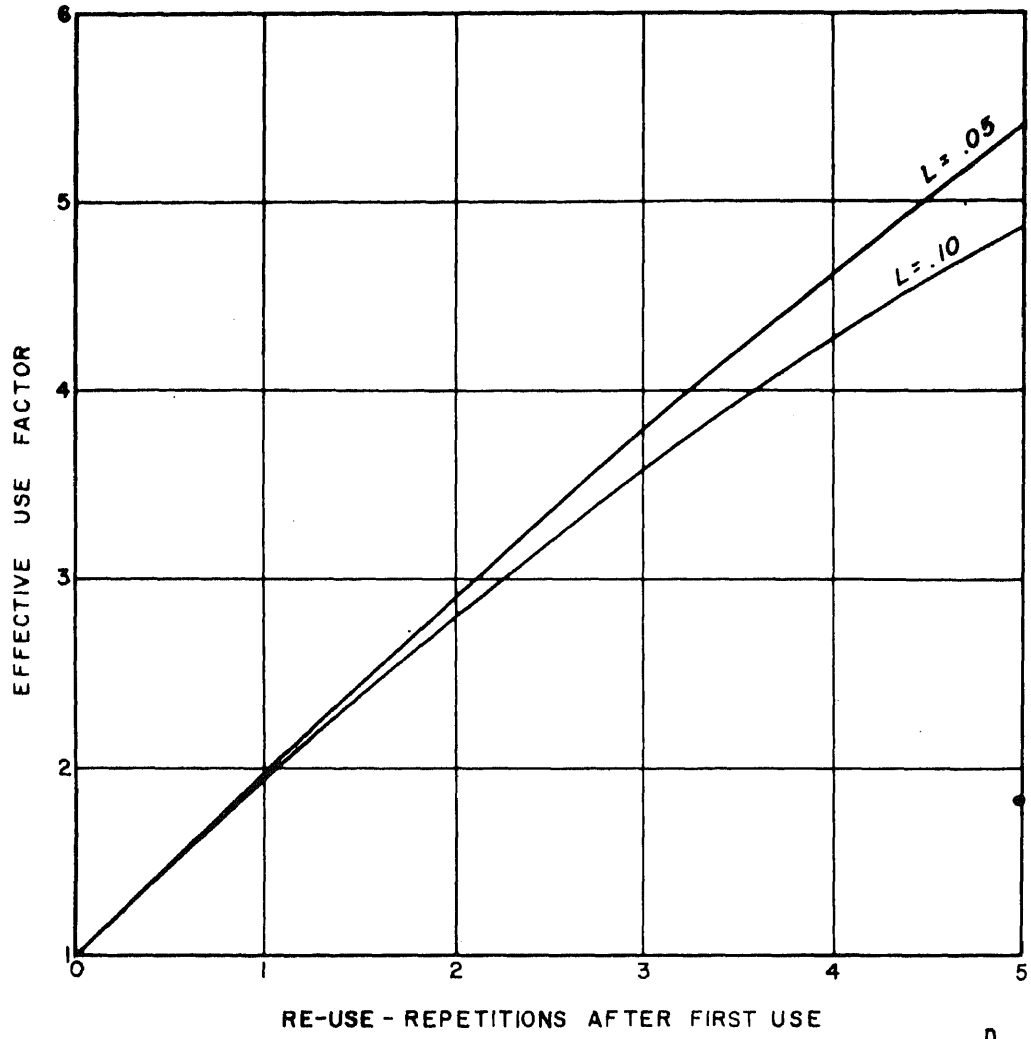
TABLE P-8

SUMMARY OF GROSS WATER DEMANDS IN PROBLEM AREAS

(All quantities in million gallons per day)

PROBLEM AREA AND CATEGORY	1955			1965			1980			2010		
	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL	SURFACE	GROUND	TOTAL
UPPER DELAWARE												
Domestic and municipal	14	12	26	20	14	34	28	18	46	49	30	79
Self-supplied industrial	8	1	9	12	1	13	18	2	20	38	3	41
Irrigation, livestock, and rural	2	3	5	3	4	7	4	4	8	4	4	8
Total	24	16	40	35	19	54	50	24	74	91	37	128
MIDDLE DELAWARE 1/												
Domestic and municipal	4	8	12	6	10	16	8	13	21	15	22	37
Self-supplied industrial	21	10	31	29	13	42	43	16	59	95	24	119
Total	25	18	43	35	23	58	51	29	80	110	46	156
LEHIGH												
Domestic and municipal	35	26	61	45	31	76	63	42	105	116	70	186
Self-supplied industrial	347	20	367	485	26	511	720	32	752	1,566	49	1,615
Irrigation, livestock, and rural	1	1	2	3	1	4	3	1	4	3	1	4
Total	383	47	430	533	58	591	786	75	861	1,685	120	1,805
UPPER SCHUYLKILL 1/												
Domestic and municipal	41	17	58	55	21	76	77	28	105	139	46	185
Self-supplied industrial	82	28	110	123	39	162	184	50	234	386	81	467
Total	123	45	168	178	60	238	261	78	339	525	127	652
TRENTON-PHILADELPHIA												
Domestic and municipal	475	112	587	598	132	730	831	169	1,000	1,472	243	1,715
Self-supplied industrial	1,157	94	1,251	1,542	118	1,660	2,225	155	2,380	4,623	258	4,881
Irrigation, livestock, and rural	5	5	10	19	11	30	24	14	38	24	14	38
Total	1,637	211	1,848	2,159	261	2,420	3,080	338	3,418	6,119	515	6,634
WILMINGTON												
Domestic and municipal	33	12	45	50	18	68	75	25	100	157	50	207
Self-supplied industrial	206	16	222	933	67	1,000	1,550	100	1,650	2,744	141	2,885
Irrigation, livestock, and rural	2	2	4	12	5	17	15	6	21	15	6	21
Total	241	30	271	995	90	1,085	1,640	131	1,771	2,916	197	3,113
SOUTHERN BASIN AND COASTAL												
Domestic and municipal	6	39	45	9	58	67	13	101	114	16	217	233
Self-supplied industrial	6	27	33	10	42	52	15	72	87	32	173	205
Irrigation, livestock, and rural 2/	5	3	8	8	38	46	10	46	56	10	46	56
Total	17	69	86	27	138	165	38	219	257	58	436	494
DELAWARE RIVER BASIN												
Domestic and municipal	608	226	834	783	284	1,067	1,095	396	1,491	1,964	678	2,642
Self-supplied industrial	1,827	196	2,023	3,134	306	3,440	4,775	427	5,182	9,484	729	10,213
Irrigation, livestock	15	15	29	45	59	104	56	71	127	56	71	127
Total	2,450	436	2,886	3,962	649	4,611	5,906	894	6,800	11,504	1,478	12,982
NYC METROPOLITAN AND SUPPLEMENT 3/												
Domestic and municipal	1,701	263	1,964	2,129	329	2,458	2,801	400	3,201	4,888	605	5,493
Self-supplied industrial	-	-	2,910	-	-	4,010	-	-	5,570	-	-	11,170
Total	-	-	4,874	-	-	6,468	-	-	8,771	-	-	16,663
DELAWARE RIVER SERVICE AREA												
Domestic and municipal	2,309	489	2,798	2,912	613	3,525	3,896	796	4,692	6,852	1,283	8,135
Self-supplied industrial	-	-	4,933	-	-	7,450	-	-	10,750	-	-	21,383
Irrigation, livestock, and rural 4/	15	14	29	45	59	104	56	71	127	56	71	127
Cooling water for thermal power 5/	3,406	-	3,406	6,115	-	6,115	12,442	-	12,442	37,779	-	37,779
Total	-	-	11,166	-	-	17,194	-	-	28,013	-	-	67,424

1/ Irrigation, livestock, and other rural water use for Middle Delaware and Upper Schuylkill included in Trenton-Philadelphia problem area.
2/ Irrigation, livestock, and other rural water use for Southern Basin only, exclusive of Coastal Area.
3/ Domestic and municipal water use for NYC & SUPPLEMENT (subregions A & B) includes rural residential use in subregion B only and excludes self-supplied industrial water use in both A & B.
4/ Projections of irrigation, livestock and rural use not available for areas outside basin.
5/ Generation estimated for service area only.



NOTE: Relation based on effective use $1+\int_0^n (1-L)^n dn = \frac{(1-L)^n}{\log_e(1-L)}\Big]_0^n$

Where L = consumptive loss as a fraction of total use.

For L = .05 effective use $20.49 - \frac{(.95)^n}{.0513}$

n = no. of repetitions of use after first use.

For L = .10 effective use $10.49 - \frac{(.90)^n}{.1054}$

REVIEW REPORT
DELAWARE RIVER BASIN

RELATION OF EFFECTIVE USE TO RE-USE

In 1 Sheet Scales as Shown
Corps of Engineers Phila. Dist.
Philadelphia, Pa. 28 Sept. 1959

Drawer No. 228 File No. 29071

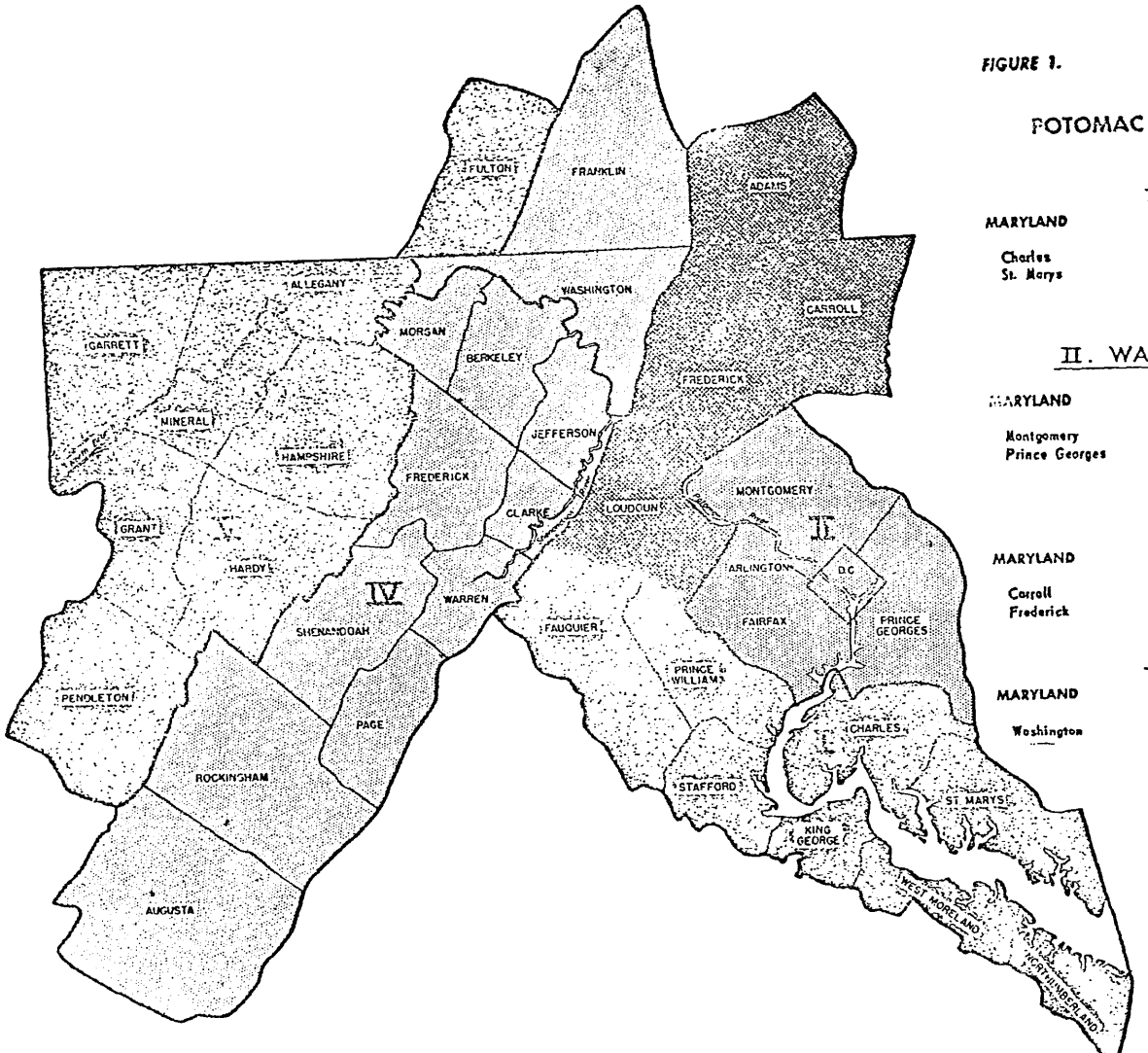


FIGURE 1.

POTOMAC RIVER SERVICE AREA BY REGIONS

I. DOWNSTREAM AREA

MARYLAND	VIRGINIA	
Charles	Fauquier	Prince William
St. Marys	King George	Stafford
	Northumberland	Westmoreland

II. WASHINGTON METROPOLITAN AREA

MARYLAND	VIRGINIA	DISTRICT OF COLUMBIA
Montgomery	Arlington	
Prince Georges	Fairfax	

III. PIEDMONT AREA

MARYLAND	VIRGINIA	PENNSYLVANIA
Carroll	Loudoun	Adams
Frederick		

IV. GREAT VALLEY AREA

MARYLAND	VIRGINIA	W. VIRGINIA	PENNSYLVANIA
Washington	Augusta	Berkeley	Franklin
	Clarke	Jefferson	
	Frederick	Morgan	
	Page		
	Rockingham		
	Shenandoah		
	Warren		

V. APPALACHIAN AREA

MARYLAND	W. VIRGINIA	PENNSYLVANIA
Allegany	Hampshire	Fulton
Garrett	Hardy	
	Grant	
	Mineral	
	Pendleton	

TABLE 18

WATER SUPPLY REQUIREMENTS (Excluding Irrigation)
(million gallons per day)

Sub-basins	Type of Use: Municipal	Industrial	Cooling	Rural, Agri.	Total
			1960		
North Branch	14	24	128	1	167
South Branch	1	-	-	3	4
Conococheague Creek	5	3	3	4	15
Antietam Creek	3	1	32	-	36
Opequon Creek	4	3	2	2	11
South Fork Shenandoah	15	10	19	6	50
North Fork Shenandoah	7	1	2	-	10
Main Stem Shenandoah	2	4	65	-	71
Goose Creek	1	-	-	-	1
Monocacy River	6	-	-	7	13
Main Stem Potomac	374	1	514	15	904
Potomac below Washington	-	-	-	9	9
TOTALS	432	47	765	47	1291
Available from natural supplies and river re-use					-1259
Net requirement					32
			1985		
North Branch	27	46	364	2	439
South Branch	2	1	-	6	9
Conococheague Creek	14	7	10	11	42
Antietam Creek	8	1	59	-	68
Opequon Creek	8	6	3	5	22
South Fork Shenandoah	34	23	40	18	115
North Fork Shenandoah	18	2	6	-	26
Main Stem Shenandoah	4	8	186	-	198
Goose Creek	4	-	-	-	4
Monocacy River	14	-	-	19	33
Main Stem Potomac	756	3	854	71	1684
Potomac below Washington	-	-	-	37	37
TOTALS	889	97	1522	169	2677
Available from natural supplies and river re-use					-1894
Net requirement					783
			2010		
North Branch	52	68	601	4	725
South Branch	6	1	-	10	17
Conococheague	27	12	17	22	78
Antietam Creek	17	2	89	-	108
Opequon Creek	16	9	5	9	39
South Fork Shenandoah	69	35	62	33	199
North Fork Shenandoah	41	4	10	-	55
Main Stem Shenandoah	8	13	306	-	327
Goose Creek	9	-	-	-	9
Monocacy River	31	-	-	33	64
Main Stem Potomac	1289	4	1194	112	2599
Potomac below Washington	-	-	-	56	56
TOTALS	1565	148	2284	279	4276
Available from natural supplies and river re-use					-1895
Net requirement					2381

CLASS C STREAM QUALITY CRITERIA
(INTERSTATE COMMISSION ON POTOMAC RIVER BASIN)

Parameter	Minimum limits
Coliform Bacteria MPN[1/] per 100 milliliters	Monthly average 500-5000
Color, parts per million (ppm), and Turbidity, ppm	Amount of color and turbidity allowed which can be removed by standard equipment and practices.
pH	6.0 - 8.5
5-day, BOD,[2/] ppm	
Monthly average	2.0
Maximum observed	4.0
D.O.,[3/] ppm	
Monthly average	6.5
Minimum observed	5.0
Other conditions	No toxic substances, oils, tars, or free acid at any time. No floating solids or debris, except from natural sources. No taste or odor producing substances. No sludge deposits.

1/ Most probable number
2/ Biochemical oxygen demand
3/ Dissolved oxygen

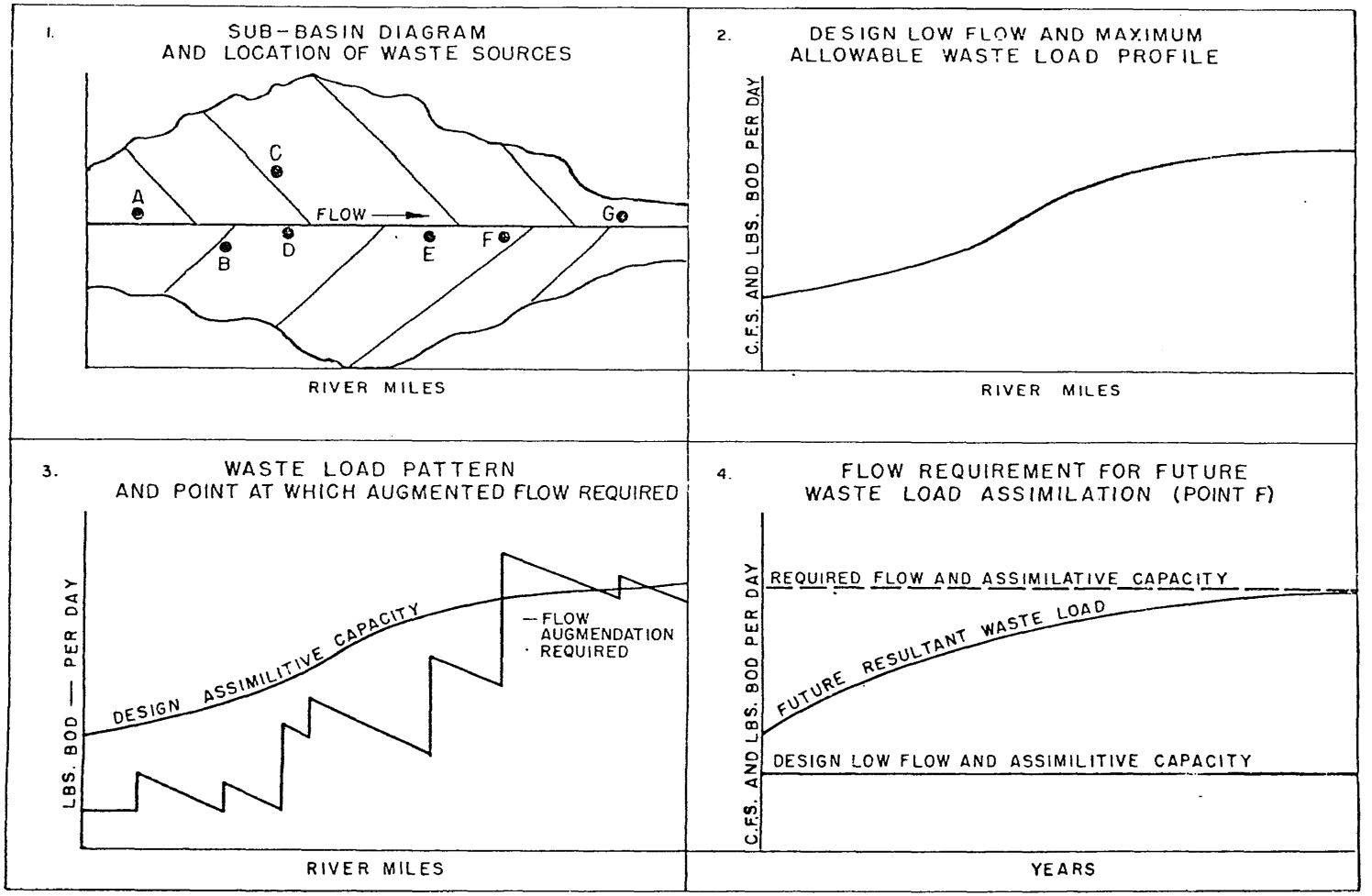
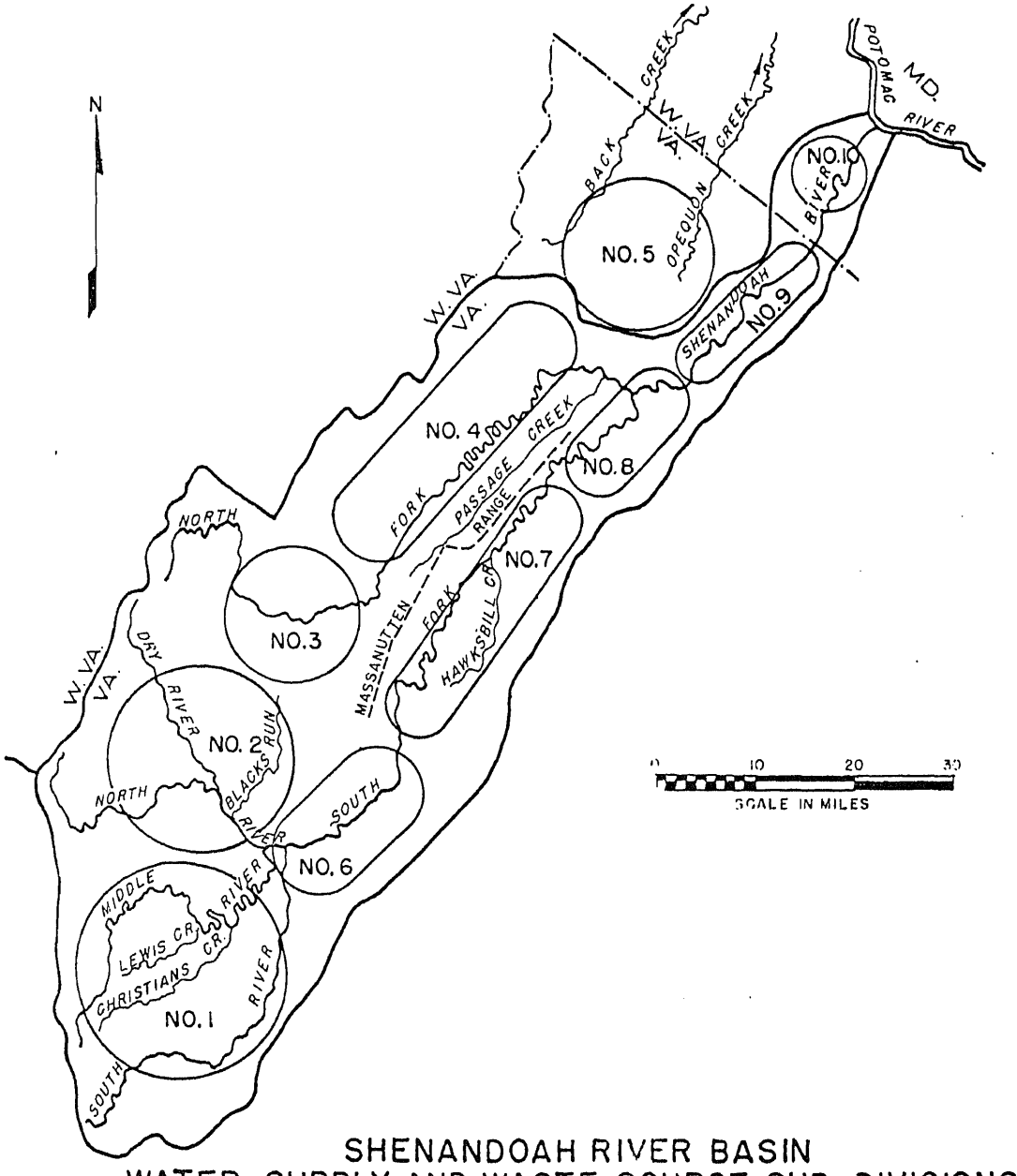


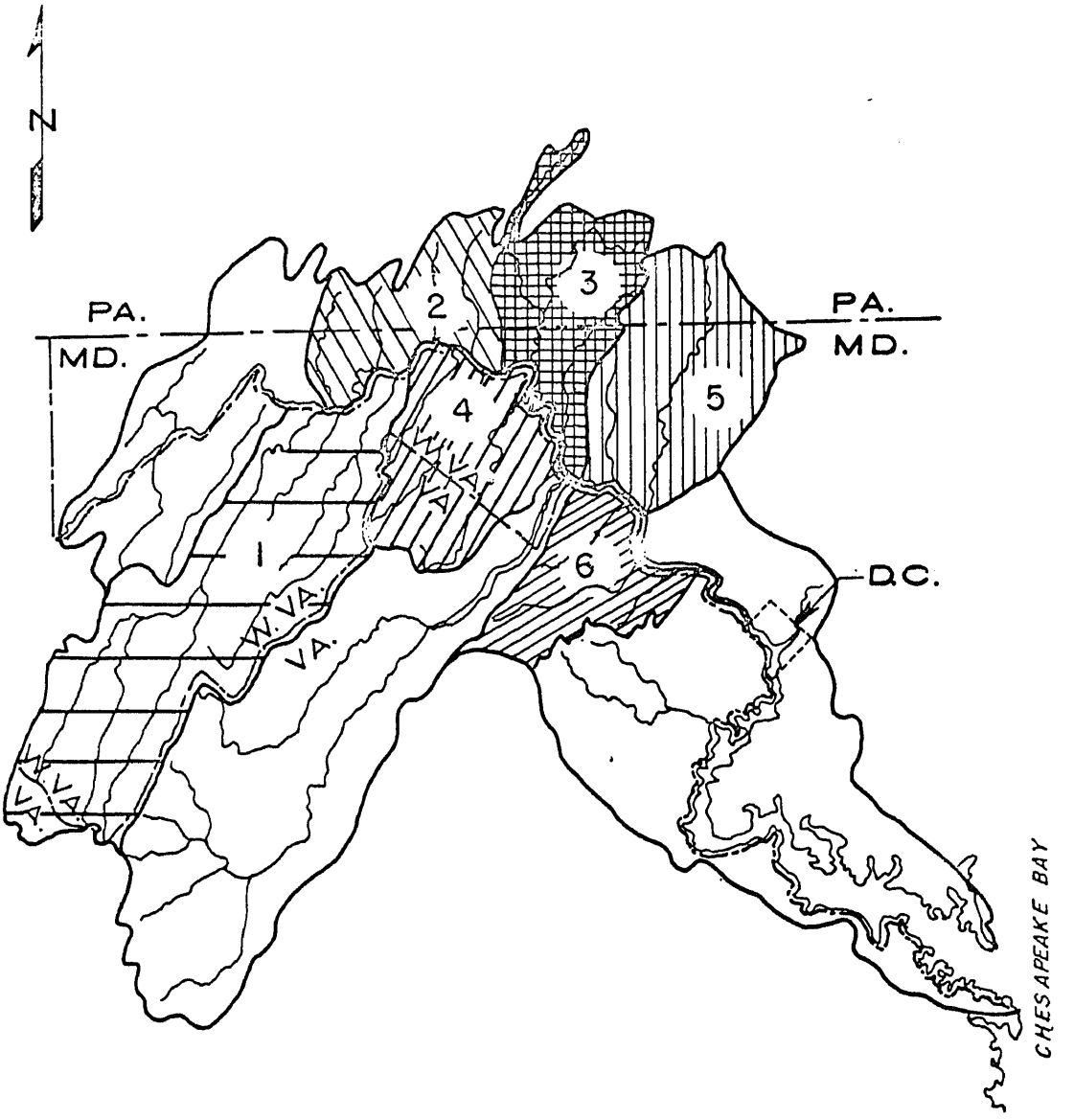
FIGURE 52

GRAPHICAL EXPLANATION OF THE METHOD USED TO DETERMINE FLOW REQUIREMENTS FOR POLLUTION ABATEMENT PURPOSES



SHENANDOAH RIVER BASIN
WATER SUPPLY AND WASTE SOURCE SUB-DIVISIONS

FIGURE 53



POTOMAC DRAINAGE AREA

SUB-BASIN STUDY REGIONS

FIGURE 73

Eric E. Bottoms, Civil Engineer,
Board of Engineers for Rivers and Harbors, Washington, D. C.

In planning river basin development certain conditions exist which together with criteria and primary data form the basis of the problems to be solved. A solution to the problems is sought by trial and error through a series of approximations. This paper dwells, generally, on the capacity determinations of present and future waterways. Ultimate congestion is demonstrated to be one of the prime factors in determining the limiting, the practical capacity of a waterway, an item of considerable importance in the planning for a new navigation project. The location of locks and dams of a navigation system may be tentatively adopted on the basis of desired depth; however, the size of the locks must be suitable to pass the barges and the towboats needed to carry the prospective commerce without undue delay. The estimated cost of barge transportation used in the project formulation report will greatly increase in the future years if, because of built-in congestive features, the prospective commerce of the future years cannot move without being subjected to costly slow-downs in the passage of the towboats and barges through the locks. This feature must be considered in determining the navigation needs for water in a basin development plan.

Basically, the provision of a navigable channel alone does not assure the establishment of traffic. There must be commodities to be shipped; there must be adequate water terminals; there must be interchange of traffic between the waterway and land transport media; and there must be suitable waterway carriers.[1] These conditions, history records, were met by an Armenian petroleum merchant about 500 B.C. He was looking for new markets, and he had resolved to take a capital risk, if necessary. He loaded a raft with stretched-hide containers of asphalt and bitumen, plus half a dozen asses, and floated hundreds of miles down the Euphrates to the port of Babylon. His venture paid off. He sold his wares at a profit, and he and his crew rode home on the backs of their animal passengers. Thus, the first step in the water transportation of petroleum products was taken.[2]

Water transportation is our oldest known form of transportation and has served our nation since its founding. In our early history, we paddled the streams in canoes and dugouts. We poled our freight

Note: Reference numbers refer to appended list on pages 308-310.

on rafts and moved along canals in horse-drawn barges. When the East coast became too small to hold us, we followed the natural water gaps through the mountains to the west, more often afloat than afoot. Lewis and Clark, two engineer officers, pushed along the waterways to explore the Great Northwest.[3]

History records the first improvement work for navigation on the Mississippi River circa 1699, when Bienville, the French explorer, removed a drift wrack to secure upstream passage of his boat. The next improvement of the Mississippi River basin was that of the French government in 1726 when, in order to deepen the mouth of the Mississippi, an iron harrow was dragged across the sea bar to loosen silt deposits which were then carried to deeper water by the currents. At that time, the controlling depth across the sea bar was some six to eight feet. Later the Spanish government did a small amount of work opening the entrances to Bayou Manchac and Bayou Lafourche from the Mississippi River.[3]

Above New Orleans, Louisiana, no improvement work was performed in the 18th Century. In 1705, the first recorded cargo (15,000 bear and deer hides) was floated and hand-paddled down the Wabash, Ohio, and Mississippi Rivers, thence in Bayou Manchac and coastal waters to Biloxi, Mississippi, to be shipped to France. The first steam boat arrived in 1811. In this period, keel-boat, flat-boat, and rafted navigation on the Mississippi was fraught with many hazards, both in the water and on the land.[3] By and large, navigation was then one-way down the big river to New Orleans, with the boatmen or raftsmen emulating the Armenian merchant of 500 B.C., returning overland.

Navigation improvements were the first water resource developments in the Mississippi River Basin. The growth of that basin has been dependent, to a very large extent, upon the navigation improvements provided by the Federal Government. Perhaps the developments in the early years were not too well coordinated; for instance, levees were higher on one side than on the other; however, there was a continuation of sound waterway and flood control improvements.

The depth available for navigation in the Ohio River in its original condition over the worst shoals at extreme low water varied from a minimum of 1 foot between Pittsburgh and Cincinnati (470 miles), to 2 feet between Cincinnati and the mouth of the river, 511 miles. When the depth over the worst shoal was 3 feet or more, the river was considered navigable throughout its entire length for steamboats and other craft, except as its use was affected by floods or ice.[4]

Gen. Robert E. Lee, as an early assignment, was given the duty to train the Mississippi River to keep it at the front door of St. Louis, Missouri. River regulation became an accepted method to provide navigable depths for medium-draft boats on rivers of moderate slope, good low-water discharge, and moderate high-water discharge, as on the Mississippi River from St. Paul to the mouth of the Missouri. When greater depths were required, it was canalized. The Ohio River, on account of its low-water discharge, could not be easily regularized for even light-draft boats; it has been canalized.[5] The art of river regulation in the United States reached its zenith on the Lower Missouri River, in Southwest Pass of the Mississippi River delta, and at the mouth of the Columbia River.

The above introductory remarks are given because of the importance of transportation in development. Our country has passed so recently from the early stages of transport to the relatively high standards of mobility it enjoys today. It was little more than a century ago that the railways finally provided a land transport system to take the place of animal and carts, and it is well within the memory of many of us when the first major efforts were begun to get America out of the mud.[6]

Now, and in the future, waterway development will and must proceed as a part of comprehensive and coordinated plans for river basins and water resources. Improvement of rivers and waterways of multiple purposes, including control of destructive floodwaters, development of hydroelectric power, irrigation, recreation, water-quality control, and other uses, as well as navigation, has become of the utmost importance. The position of inland waterways and modern barge lines as efficient and economical movers of bulk cargoes has been amply demonstrated. Further recognition and use of this transportation medium will influence the location of future industry and urban development.[7] In some basin-wide plans, it will be found necessary to deepen existing waterways, to replace locks, as they grow obsolete, by structures able to handle the commerce of the day, and to extend waterways in the less developed areas. For instance, the physical deterioration of many of the existing locks and dams on the Ohio River has caused the formulation of a plan for replacement requiring a construction program extending over a period of years. The possibilities of providing a more efficient waterway, to handle the increasing volumes of traffic which could not be handled by mere reconstruction of the existing structures, have led to the adoption of a replacement system composed of larger and fewer structures.[8]

The primary purpose of providing new waterways, including extensions thereof, and the modification of existing waterways is to provide facilities from which transportation service to the public can be made available at less cost than presently available.

Present-day navigation projects include the construction or modification of waterways and canals, channels, and harbors. Basin planners are generally interested in inland waterway improvements which are accomplished by canalization, open-river regulation, clearing and snagging, and the dredging of both natural waterways and canals. They are particularly interested in the canalization of natural waterways, rivers, by the construction of locks and dams in order to create adequate widths and depths for navigation. Modifications of canalization projects may include the substitution of a modern lock and dam for one or more obsolete locks and dams. Open-river regulation is accomplished by channel training, construction and stabilization by reservoir regulation of flows to create and maintain navigable depths. Clearing and snagging improvements consist primarily of removing overhanging trees, stumps, logs, boulders, and other obstructions and hazards to shallow-draft navigation in a natural channel.

The major objective of evaluating navigation benefits is to obtain an average annual benefit figure which can be used for comparison with the average annual carrying charges of the project. A second objective is to measure the annual benefits from existing navigation facilities. Uniformity of the techniques involved is essential to insure that all projects are analyzed on a common basis. The evaluation of navigation benefits varies with the type and purpose of the improvement and the nature and use of the facilities provided.

In computing transportation savings, it is necessary to compute the costs for each movement of prospective traffic from point of origin to destination via the proposed waterway route and compare it with the transportation costs via the least costly available alternative route. The savings so computed are usually expressed in dollars or cents per net ton and applied to the average annual prospective commerce. When a proposed waterway improvement will develop new waterway movements which will move on existing or connecting waterways, the estimated transportation savings for the complete movement are credited to the new waterway, no part of this saving is assigned to the connecting waterway. When a proposed improvement will result in the extension of an existing waterway, only those transportation savings resulting from the extension of the movement are included as benefits. In certain instances, however, the extension of a waterway

will attract new traffic to the waterway, then the estimated transportation savings are computed as the difference between the transportation costs via the extension and the least costly alternative route.

Forecasting the prospective tonnage for a new waterway or the improvement of an existing one involves judgments as to the nature of future forces which will act upon the decisions relative to the routing of traffic among the types of carriers, alternate routes, completion between sources, the cost of carriage, possibility of substitution of alternative materials, and many other considerations. In addition there are basic considerations of the general level of economic activity of the region the route serves and the necessity for an evaluation of the factors affecting the levels and character of economic activity in those regions. The task of preparing such forecasts is complex, and the results will be bound to have a large margin of error. Simple projection of past trends is inadequate, even though past trends may provide a base line upon which the judgments of future changes in the relative importance of existing forces may be made. Projection is of little or no value in considering the possible impacts of forces which have not existed in the past but which may enter the picture in the future. The magnitude of the effects of such changes upon the waterway traffic cannot be estimated by any statistical techniques, and they are principally arrived at by admittedly crude judgments.[9]

Professor Hartley, University of Indiana, in commenting upon the Tennessee-Tombigbee Restudy Report had this to say about forecasting:

> "Prognostication in an uncontrolled environment is always uncertain and economic prediction is no exception. Nevertheless, it must be done if private and public investment decisions for new transportation facilities are to be made on a rational basis, whether the forecaster is asked to look 20, 30, or 50 years into the future. Economics is sometimes called the dismal science and not the least of the reasons is the fact that economic forecasting cannot be exact; therefore, many economic forecasters, being aware of the pitfalls in predicting, have decided it is better to underestimate growth rates than to overstate them. If this leads to repeated failures to make capital investments that actually will produce substantial returns, then the nation or the private investors lose as they lose if capital is sunk in unprofitable ventures."[9]

Along with forecasting, evaluating factors affecting the level and character of economic activity, projection of historical trends, and other duties, it seems to me that basin planners should give considerable attention to the determination of the practical capacity

of the waterway improvements they propose. They should recognize that the slowdown and decreased efficiency in waterway movements, as the traffic exceeds the practical capacity and approaches the project's theoretical, physical capacity, results in increased carrier costs. This congestion has the effect of driving the high-grade commodities off the waterway; that is, the traffic on which the savings to the shipper are the greatest will leave the waterway when the time in transit becomes too long and the carrier costs, and interest on investment in the commodities, hence charges to the shipper, via the waterway begin to approach or equal the next lowest cost alternative carrier.

Traffic is seldom heavy enough on open waterways, like the Mississippi River for instance, to impose serious route-capacity restrictions. However, narrow channels, locks, and harbor entrance may impose rather severe restrictions. On any waterway, traffic is restricted to that which can move through the limiting section in a given time according to the principles just set forth. In open channels, a headway limited by the stopping distance must be observed. In passing through locks, a headway equal to the time it takes to lock through a vessel or a tow is automatically imposed. The time may vary from 20 minutes to an hour or more, depending on the size and flow capacity of the lock and on the number of units in the tow. [10]

The size of navigation locks can have a major effect on the economic success of any waterway. A basin planner, if he adheres to the bare minimum in all instances, may tend to provide for only minimum lock size based on the physical capacity of the lock to pass the annual traffic. Such a plan will never result in the realization of the predicted tonnage, as the traffic will not blossom on a minimal plan with such built-in restrictions. That is, the locks can be so small that the prospective waterway traffic as estimated by the planner will not develop because of excessive delays, or so large that the costs, both fixed and operational, will make the project uneconomical. Since a lock has a useful life ranging up to 80 to 90 years or more, and since it is expensive to alter after it has been constructed (for instance, consider the expensive lowering of the gate sills of the locks on the New York State Barge Canal), it is extremely important that the proper size be selected at the outset." [11]

The Engineering Manual on Navigation Locks does not direct that any specific size must be used for any expected trade on any specific waterway. The Manual is for the guidance of those elements within the Corps of Engineers responsible for design and construction of navigation locks. The basin planners who consider improvements for navigation are considered to be one of these elements. It is stated in the Manual that it is not intended to set up rigid rules that must be followed in every instance, but rather to outline the many problems and to indicate some of the

assumptions and solutions which have been used in the past with some success. While several locks in the United States have been replaced because they were worn out, an even larger number have been replaced because they were too small to handle the traffic volume.

On a railroad, the basic element is the single track, whose capacity to move trains depends upon various types of operating arrangements. A single track, which is used solely by trains moving in one direction, has a capacity which exceeds a single track carrying multi-directional traffic. In either event, practical capacity will be dictated by the kind of signals provided, their spacing, and by the average speeds at which trains operate. Not all kinds of trains operate at the same speed, so that with a mixed traffic pattern, in which fast passenger or merchandise freight trains must be accommodated together with the slower local or "drag" freights, some of the capacity will be absorbed so as to bypass the faster around the slower train movements.[12] As it is with railroads; so it is with waterways, with their high-speed integrated tows, sand and gravel "drags", moderate and high-speed recreational craft, and other craft and tows of varied types.

With a double-track line, having automatic block signals, the capacity of a railroad is more than double that of a normal single-track line handling traffic in both directions. If the double track must handle maximum traffic (i.e., trains operating at different speeds), its capacity is lower than if it were to handle trains moving at uniform speeds.[13]

These statements concerning railroad capacity illustrate several of the common pitfalls which transportation planners must guard against. Navigation planners should not forget to integrate the economics of movement into the sizing of the improvement.

Several years ago, in a report on the Allegheny-Genesee Through Waterway, it was pointed out that the actual operating records for the locks on the lower Allegheny River showed that they often reach their daily capacity for several consecutive days at repeated intervals when the annual tonnage was between one-half and two-thirds of the theoretical capacity. It was stated that a lock in the Pittsburgh District, which has a theoretical capacity of 31 million tons per year had reached its daily operating capacity repeatedly when the annual traffic amounted to about 17 million tons. This is only 55 percent of the theoretical capacity.[14]

It seems to me that the basin planner, when considering an improvement for navigation, must give careful attention to the practical

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capacity of the waterway improvements he proposes. He must recognize that on a seasonal waterway he must recognize seasonal peaks.

In the recent report on the duplicate locks proposed for the Illinois Waterway, the planners ascertained, from the 1953 records for each lock, the lockages for the peak day, the peak week, and the peak month. The number of lockages per day accomplished in each of the respective intervals multiplied by the average lockage time (minutes) gave the estimated total time per day the given lock was in use. The percent of time the lock was in use is found by dividing its total time in use by the total time in the day.[13] The practical capacity is obtained by dividing the tonnages actually passed in 1953 by the percent of time the locks were in use. Data on Brandon Road Lock is as follows:

Average number of lockages/day during peak month 15.6
Average lockage time in minutes 59.3

$$\frac{15.6 \times 59.3}{24 \times 60} = 64.2 \text{ percent}$$

Lock actually passed - 13,430,000 tons in 1953
If operated continuously $\frac{13,430,000}{0.642} = 20,900,000$ tons

In 1953, tonnage passing Brandon Road was 81.4 percent of that handled in the Illinois Waterway below Lockport. Consequently, it is estimated that on the stated basis of using the peak month, the present Brandon Road Lock limits the practical capacity of the Waterway below Lockport to 20,900,000 divided by 0.814, or 25,700,000 tons annually.[13]

It should be noted that computed lock capacities are smallest when predicated on peak-day lockages, that they are increased when based on the total annual lockages.[13] Congestion at the locks impedes optimum movement of traffic and causes delays to traffic. The record indicates that three of the seven Illinois Waterway locks operated over 90 percent of the time on peak days during 1953; this represents an extremely high load factor for those days. Likewise, when considering periods as long as a month, the Lockport lock operated over 70 percent of capacity based on peak month lockages. Apparently, some congestion can be and has been accepted by navigation interests. Estimates of lock capacities, based on peak days or peak weeks, are generally considered unduly conservative, inasmuch as they are predicated on extreme conditions, which occur only from 0.25 to 2.0 percent of the time, and do not allow for more uniform distribution of traffic, which occurs a major portion of the time.

In contrast, estimates of lock capacities based on the total annual lockages cannot reasonably be considered realistic, inasmuch as they are predicated upon a completely uniform flow of traffic at all times, which is not obtainable. It is impossible for any waterway with diversified tonnage, carried in widely varying types of equipment propelled by equally variable types of propulsion units, to have a record for any prolonged period of time of 100 percent theoretical capacity. Consequently, in regard to the Illinois Waterway, estimates of lock capacities based on lockages which occurred during the peak month were considered as the most representative since they were predicated neither on extreme conditions which occur at infrequent intervals nor upon ideal conditions which would produce maximum lock efficiency but are not obtainable.[13]

Lock capacity is governed by the number of pieces of tonnage carrying equipment it can pass. Maximum tonnage capacity depends upon the loading of the equipment which the lock passes. For any given period of time, the maximum number of lockages that can be made at a lock, on the basis of 100 percent utilization, is limited by the time required per lockage. The maximum tonnage which may be passed through the lock during any period of time is dependent on the maximum number of lockages that can be made and the tonnage per lockage. In the case of the Illinois Waterway, the average tonnage per lockage which would have occurred in 1953, for the five upper locks has been estimated to be approximately 2,900 tons, based on the breakup of tows above Lockport. Thence, the maximum annual tonnage, or maximum annual capacity of any lock on the waterway based on 100-percent utilization and an average tonnage of 2,900 tons per lockage, is equal to the maximum number of lockages that can be made in one year (number of minutes in one year divided by time required per lockage in minutes) multiplied by 2,900 tons.[13]

The 2,900 tons per lockage, as stated, is an average and does not take cognizance of what could have been locked through. The 2,900 tons per lockage automatically included large tows with large tonnage and small tows with little or no tonnage. The average tonnage that could have been locked through per lockage would be considerably higher. However, we are not concerned, except in an academic way, with theoretical capacities, but with practical capacities, based on actual conditions that are expected to exist rather than on theoretical conditions which experience indicates would not exist.

Dr. Joseph H. Carroll in his doctoral dissertation on the Tombigbee-Tennessee Waterway states that the maximum theoretical capacity for any lock is determined by the maximum number of tows that can be locked through in any time period and that, on the other hand, economic capacity takes into account the cost of delays encountered as maximum capacity is approached. Thus he recognizes the rising cost of transport as the lock becomes congested. In determining lock capacity, he points out the critical importance of the pattern of arrival of tows at the lock and that it is not only the average number of tows per day that arrive must be known, some assumption must be made concerning the manner in which they arrive; in other words the time between arrivals. If tows arrive at the right time, the lock can accommodate 40 a day with no delays at all if the total lockage time is 36 minutes. However, he points out, "such traffic discipline can hardly be expected."[15] Tows, like streetcars and bananas, come in bunches.

On a dead-end waterway, an even balance of tows in both directions can be assumed. This assumption will not necessarily be affected by unbalanced tonnage if one assumes that every barge that goes up must eventually come down, full or empty.[15]

Traffic discipline, to attain 100-percent efficiency of locks, is an ideal but impractical solution to obtaining the theoretical capacity of the controlling lock on a waterway. If this efficiency were obtainable, we would have an ideal situation and the maximum possible capacity of locks and waterways could be realized. There would be a constant flow of traffic through the locks with passage being alternated between upbound and downbound tows. Arrivals and departures of tows from locks would be properly spaced as to time. This would imply perfect spacing of tows and constant speed throughout the waterway. Such rigid discipline and scheduling would be applicable to recreational craft, as well as commercial craft.

Disciplining and regulation of waterway traffic is idealistic but not realistic. If it could be applied to waterways, it could likewise be applied to streets and highways. You would be told when you could come out of your driveway of your home and proceed to the office, your route would be mapped and you would be required to adhere to and maintain speed and position, and to yield "one and one," as designated. No rugged American individualism would be tolerated. Streets and highways are planned to handle peak traffic which occurs at certain hours of the day, or on certain days of the week, or in certain seasons of the year. The size and capacity of certain principal streets and highways could be materially reduced if it were possible to regulate and discipline vehicular traffic to reduce traffic peaks. The impracticability of doing this is obvious.

It seems to me that a somewhat similar situation pertaining to disciplining and regulation exists with respect to railroads. While railroads are private undertakings, in contrast to waterways and highways, which are public facilities, and as such can exercise better control and regulation of their traffic, they are still subject to peak movements of rail traffic ranging from minor to major importance. If the railroads could regulate their traffic to eliminate all of their peaks or reduce some of the present peaks, undoubtedly they could handle considerably greater volume with their present facilities (trackage and terminals) or effectively reduce their present facilities without adversely affecting their ability to handle their present traffic.

I note that lock operators make use of all available facilities, including radio, to keep in contact with tows and to arrange for lockages. The mere announcement of a tow by radio that it anticipates arrival at a lock at a certain time is not a solution to the congestion and capacity problem. Several tows may be approaching a lock from the same direction or in opposite directions. Their announced time of arrival is at best approximate and there are many factors which may result in either a late or early arrival. The dependency or accuracy of estimated times of arrival is dependent to some extent on the distance the tow is from the lock. The farther away the tow is from the lock, the more inaccurate may be the estimated time of arrival. Preparation of a lock in anticipation of arrival of a tow prior to an arrival of a tow from the opposite direction, may result in longer delays to all concerned, if the tow from the opposite direction arrives first. Thus, it is necessary to use announced arrival times. The tow arriving first must be locked through first, under normal operating procedures. This is no different from a public highway where the cars arriving first pass through first. Under public use of a transportation facility, first there, first served. The delays caused to tows due to preparation of locks for lockage are inevitable, even under the present system of using all available communication facilities, including two-way radio, and cannot be eliminated.

It is noted that in some navigation studies the lockage time appears to be an absolute one time experienced minimum, and in some instances even less adequate. Lockage time should be defined in detail to avoid misunderstanding and to permit proper consideration. The use of an entrance time of 11.8 minutes at Lockport Lock was misunderstood by the railroads. An analysis of this time is interesting and will illustrate to the basin planner the reasons for not accepting excessively low rule-of-thumb estimates of entrance time as a component part of lockage time. Entrance time, as used, involved starting of the tow probably from a complete halt (and it

will be from a complete stop on most congested waterways where the practical capacity is reached or is being exceeded) outside the lock chamber, passing into the lock chamber, and coming to a complete halt inside the lock chamber. The total distance traveled is probably 900 feet or more. Traveling 900 feet in 11.8 minutes indicates an average speed of 0.87 miles per hour in effecting entrance to the lock. Considering the fact that tows on the open river do not normally travel more than four (4) miles per hour on the average, and considering the difficulties of navigating into a lock, the 11.8 minutes is not excessive. This applies to departure time as well as to entrance time.

Lockage time includes the time it takes to fill and empty the locks--which depends on many factors, one of the principal ones being the differential in head between the water elevations in the upper and lower pool. If such differential head was constant, the use of theoretical rating for emptying and filling of locks could be simply computed and used in the compilation of lockage time. However, the differential in head varies daily and to arrive at a theoretical time for emptying and filling, a thorough analysis would be required, based on frequencies of water elevations in the pools, together with rating of culverts for various pool elevations.

Again, in reference to the Illinois Waterway, the records show that locking delays increased 24 percent between 1950 and 1957. The average size of tow, in terms of tonnage, rose 75 percent in the same period, meaning that each hour of delay was 3 times as serious as the elapsed time would indicate.[16]

These experiences are related to alert the navigation planners, to encourage them to study the records of going navigation improvements so they will realize that locks are never operated 100 percent of the time, that tows are not always lock size, that barges are not always filled to capacity, and that there are times on each and every waterway when delays occur. Theoretical capacity is unreachable, the problem is to determine a reasonable practical capacity which can be realized without unduly increasing the carrier costs as the tonnage approaches the practical capacity of the waterway. It would be ideal, of course, if the planner could compute the increased carrier costs as the tonnage increases according to the projection curves set forth by the "dismal scientists." This would place another element in the equation when computing the present worth of future savings in costs between the waterway and the lowest cost alternative.

It seems to me that it must be demonstrated that projected traffic in the later period of project life will not exceed the

practical capacity of the waterway. If it does, then either the benefits on excess traffic may not be claimed or the cost of the additional capacity required to handle this traffic must be considered in the initial benefit-cost analysis. Also, the traffic credited to a proposed waterway usually includes some traffic that must be carried by existing connecting waterways. The cost of delays on existing waterways due to congestion caused by the addition of the proposed waterway is chargeable to the proposed waterway. Likewise, the proposed waterway must bear the cost of additions to capacity of existing waterways, to the extent that these additions are required sooner than they otherwise would be.

It seems to me that no canalized waterway can be expected to have the same efficiency in the years when its practical capacity is being achieved or exceeded that it had in its formative years and those prior to approaching its practical capacity. Hence it is logical for the estimated cost of movement for those years after reaching practical capacity to be higher than for the years before. If the prospective commerce for a proposed waterway is estimated to equal its maximum theoretical capacity, a capacity 25 to 50 percent greater than its probable practical capacity, the barge costs used in evaluating its benefits should be higher than on any comparable existing waterway as no existing waterway operates at maximum theoretical capacity. The barge costs would be still higher for those waterways estimated to reach their practical theoretical capacity early in their project life.

The basin planner must be assured that he has sufficient water supply available in the upstream reservoirs, or in those on the tributaries, to supply the complete needs for the navigation plan as well as for other needs of the basin. The navigation needs for water is for that amount necessary to operate the largest practical size lock at the highest practical capacity. True, some reserve water supply must be planned, but the total amount for the efficient operation of a canalized river will not normally exceed that amount determined by a competent hydrologist for evaporation in the navigation pools, lock and dam leakage, and water to operate the highest lift lock the maximum possible number of times per year.

Goals and objectives for river basin development should be clearly stated by the top policy-makers at the outset of planning.[17] It is the preliminary study of any project which calls for the highest degree of engineering judgment, talent, and experience. The final design and its analysis are usually of a routine nature. However, it must be noted that where water-resource development

engineering is concerned, i. e., basin planning, no one plan will be for all time the best plan to develop the full potential of the valley. Not only are new methods in the engineering use of materials being developed, but new meteorological and hydrological occurences add to the knowledge basically necessary for the design of water-resources development works.[18] Economic and social changes in community developments have their effect upon water-resources development. There is no single uniform policy, no magic formula relating to basin planning of water resources which can be applied to all parts of the country at all times and in all places.[19] The future changing pattern of economy of the regions, and the shifts and growth of population, require the highest degree of judgment available to cope with the unknown future realities of the water resources needs of an area.

The goal of this paper is aimed towards water needed for navigation. This includes a determination of the practical capacity of a planned waterway development. That is, for a basin plan report which considers the possible canalization of the main stem or one of its branches, it is necessary to know how much water is needed for the proposed navigation. This navigation need must be met or else there is no navigation. How much water is required? The answer appears patently easy. - But, is it? The largest lock with the highest lift naturally controls the water demand. - Plus the incremental demands for increased evaporation, i.e., larger pools lock leakages; etc.

But how often will the largest lock with the highest lift be operated? How fast can it be operated? What will be the pattern of tow arrivals? When does peak lockage demand occur?, i. e., what month of the year? For instance, on this basis, TVA computes the practical lock capacity for the 110- by 600-foot lock at Pickwick Dam at about 21 million tons per year, based on present tow size and composition of traffic.

On planning a new waterway improvement, there are no technical or economic studies which can accurately predict long-range needs for navigational water in any valid detail.[20] Any statistical projection, however refined, has its basis in the assumption that the forces which have acted in the past will continue to act in the future and that the trends in the rate of change of these forces will continue into the future as they have operated in the past.[21]

Mr. Peter F. Drucker, in "The Practice of Management", (p. 89) a book on the recommended reading list at the Army Management

School, states that "Predictions concerning five, ten or fifteen years ahead are always 'guesses'. Still there is a difference between an 'educated guess' and a 'hunch', between a guess that is based upon a rational appraisal of the range of possibilities and a guess that is simply a gamble."[22]

The amount of water to supply "Navigation Needs" depends upon possibilities - many of them. I want to talk about possibilities for a few minutes.

On any given waterway, is it possible that:

a. All barges will be loaded to their maximum capacity;

b. All tows will be lock size;

c. All towboats will be properly powered;

d. All locks will be ready at all times to receive the next tow;

e. All tows will enter lock with no difficulty or delay;

f. All locks will be undamaged at all times; and

g. No delays to traffic will be encountered at any time; that there is no, and I mean no congestion at any time.

Name me one waterway, existing or proposed, that can meet all of these points. Then I will name the one waterway that might possibly operate at maximum theoretical capacity. No waterway ever operates at maximum physical, theoretical capacity. No waterway operates near such capacity for an extended period.

Mr. Brewer, in a paper delivered before ASCE in Detroit, stated that the capacity of the existing Ohio River waterway will not permit continuation, for many additional years, of the rate of growth that has been maintained in the past.* * * indicated physical capacity of the locks is about 45,000,000 tons annually * * * a practical value between 30 and 35 million is considered probable, taking into account effects on economics resulting from congestion delays as the density of traffic approaches physical saturation.[23] These quoted figures indicate that the practical capacity for a waterway ranges from 66 to 77 percent. Another way of saying this would be - recognizing that as the lock capacities approach saturation increasing delays would occur and that a conservative practical capacity would probably be in the order of 70 percent.[24]

In a recent report on the Illinois Waterway, prepared by the Chicago District, it is stated that "Operation of the locks on peak days has exceeded 90 percent of capacity at 3 of the locks, and averages about 70 percent at the remaining 4 locks."[25] This is an extremely high capacity factor, and is greater than is customary for other forms of transportation.

Occasionally, waterway planners are unwilling to face up to the practical realities of life. They assume full barges and lock-size tows pushed with minimum power at high speed, and assume no delay. Unfortunately, these are not the facts of life. Past experience has indicated that tows will not arrive at a uniform rate, even when passed through a nearby lock at intervals of time required for locking. This condition results from differences in speed of the various tows and required terminal operations between locks. No material change in the future of these use patterns appear likely. As traffic and lock use time increase, the delays to tows at locks increase. For example - Average tow delay time at Lock 52 (Ohio River), with use time of 60 percent of that available, was over 3 times the delay at Lock 15, with use time of 32 percent. Further increase in lock use may be expected to be accompanied by progressive increase in tow delays until a point is reached where the delay becomes too burdensome to permit further economical traffic movement. Obviously, this rate lies between the current rate of traffic movements and the physical capacity of the lock.[23]

The maximum theoretical capacity of the Black-Warrior-Tombigbee Waterway, Alabama, is about 35,000,000 tons annually. The practical capacity, based on composition of prospective traffic, is stated to be about 12,000,000 tons; or, if on a more balanced movement of bulk commodities could be obtained,to be about 15,000,000 tons.[26] This indicates a practical capacity of about 43 percent. - This seems very low.

An unsung benefit on several of the rivers is the recreational qualities.[27] Some people, particularly the commercial barge operators, do not consider recreational craft beneficial. In fact, the use of the Illinois Waterway by recreational craft is continuing to grow, thus reducing its capacity to serve commercial navigation.[25] Based on available lockage time, the maximum reduction in capacity could be as high as 25 percent, theoretically--practical capacity of this waterway of the locks insofar as com-

mercial tows are concerned would hence be reduced about 25 percent. In this connection, benefits to recreational craft, we need a new formula by which to determine the benefits accruing to recreational small boats on our navigation projects.

George Robey, an English friend of mine, used to tell the story of the cockerel who, having found an ostrich egg, called the hens together and said that, while he had no wish to complain, he thought it only right to point out what was being done elsewhere.[28]

What is being done, or is experienced elsewhere, is information which is vital to our reporting activities. Without such overall progress in the realm of basin planning would be slowed down.

SUMMARY -

My final comment is this. I have written most of this statement about a half-dozen times, in an attempt to set down the basis upon which congestion, waterway capacity, water needed for navigation can be thought about, studied, and discussed. I have done such limited research as time has allowed me, to see if someone has not already done the job, but I have not found a satisfactory statement.

I do not speak in modesty when I say that the attempt to achieve the goal as stated at the beginning is, in my considered opinion, quite inadequate, but, being ignorant of the availability of better statements, I decided to put them before you in the hope that they might stimulate the emergence of something better.

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The development of concepts of the multiple-purpose project and of comprehensive water resource development has been closely associated with the planning of projects which include hydroelectric power. A large number of the major river systems of projects which have been planned from a comprehensive point of view, such as the Columbia, Missouri, Savannah, Alabama, Roanoke, and White River Basins, have included the production of hydroelectric power as one of the principal purposes. The result is that, as of today, most of the Corps' larger multiple-purpose projects include power as a major purpose, and that 2/3 of the investments in those projects have been made for power.

It is expected that power will continue to be a primary element in future comprehensive river basin plans. In future planning however, greater attention will have to be given to the development of power in relation to the needs of other purposes. Until recent years, comprehensive plans have been largely concerned with flood control, navigation, and power, but in the future equal consideration must be given to fish and wildlife, recreation, water quality control, water supply, and other uses. However, the storage and regulation of flow associated with hydro power generally lends itself very well to the development of projects for other purposes which depend upon this same storage and regulation of flow.

Methods now used in evaluating power needs employ the comprehensive approach from the standpoint of meeting regional power requirements. Normally a need for project power is established on the basis of an analysis of the overall requirements and load growth of the power region in which the project is located in relation to the characteristics of the power from the project that can best be developed to serve projected needs. Long-range needs are also considered in order that proper provisions may be made to protect the future power potential of a site. Another factor which is investigated separate and apart from economic analyses is the marketability of power. This additional test is made to determine whether, under practical market conditions, it will be possible to obtain revenues from power sufficient to recover power costs.

From the point of view of comprehensive basin planning it is not sufficient only to balance power installations against power needs. The Corps must, in addition, accommodate the development of power to an optimum overall project development for all beneficial uses. Although power reservoirs create the conditions from which benefits from some of the other purposes flow, modifications of power installations may be indicated to achieve the best overall development. For example, in many cases it may be desirable to place restrictions on power drawdown in

order to realize a more attractive reservoir for recreation purposes. From a comprehensive standpoint, it sometimes may be advisable to operate power facilities over week-end periods when they would normally be shut down in order to realize greater benefits of water quality control. Possibilities for seasonal operation need to be examined closely to determine if gains from other purposes obtained thereby will permit a better overall development. The comprehensive viewpoint should also recognize the seasonal nature of flood control needs and possibilities for seasonal power drawdown to meet those needs.

In addition to refining present techniques to better adapt power development to the needs of other purposes, continuous attention will need to be given to the rapidly changing technology of the power supply industry if power facilities are to be installed that will best meet power needs of the future. All forecasts indicate an enormous and continuous growth in power requirements throughout the nation, and to meet such requirements, power supply systems will be able to absorb practically all the generating capacity we can economically install in the water resource projects. It is expected that the ever-increasing emphasis on peaking capability will be continued into the future. In the early days of flood control and navigation programs, it was customary to consider the amount of capacity to be installed in terms of load factors of around 25 percent. Peaking needs have continuously increased, however, and it is not unusual in present studies to consider the installation of equipment that will permit hydro plants to operate at load factors as low as 3 to 10 percent. We are continuously increasing the generator capacity of Corps hydro plants to the extent that only 9 of the 37 hydro plants now in operation have empty stalls without definite plans for future use. With the tremendous increase in the need for peaking power, we would expect that the size of the ultimate installation provided for in many future plants will be determined by physical limitations, requirements of other purposes, etc.

In analyzing power needs, and the place of hydro in meeting those needs, we must keep in mind the research now going into the development of new ways of generating and transmitting power. New techniques portend what may be something of a revolution in the power supply industry as we know it today. One of the chief elements of the tomorrow's power supply system will be the nuclear power plant. Nuclear power is already on the verge of being economical in high cost power areas and forecasts indicate that by 1980 a very significant part of our requirements will be met by nuclear power. Transmission at voltages far greater than have been used in the past appears to be just around the corner. Such lines will permit the integration of geographically separated power systems, and promote the increased development of mine-mouth thermal plants. Transportation of coal by pipelines is also being given much attention at the present time. Possibilities in the use of pumped storage and diesel and gas-fired peak power plants are just becoming to be recognized and it may be expected that much greater use will be made of these types of developments in the

future. We must also not lose sight of the fact that a great amount of research stimulated in a large measure by the space and military programs is going into the so-called new exotic methods of power generation. Where this research effect may lead to and its impact on the power supply systems of tomorrow can only be conjectured but the effects can be considerable. It is too early as yet to fully anticipate the role of hydroelectric power in tomorrow's power suppy systems, but indications would lead us to believe that we will have many new considerations to take into account in planning for power development.

With our pattern of our future power supply so uncertain, the question arises as to the advisability of extending the period of economic analysis for power to 100 years. It is true that the art as now practiced may become obsolescent before the end of a 100-year period. In project formulation, however, it is desirable to obtain a balance among the various purposes served that will result in the maximum benefits from all purposes over the useful life of a project. To accomplish this objective it is necessary to deal primarily in probabilities, even if it involves some risk due to changes in technology. On a probability basis, it appears most likely that power will still be produced by hydro plants 100 years from now. Several other factors are also to be considered in this connection. Present reimbursement policies contemplate recovery of the power investment in 50 years, which greatly reduces the risk involved in obsolescence. In addition through the provision for major replacements in the Federal project, the costs of specific power facilities are analyzed on the basis of a lesser period than 100 years, corresponding generally to the useful life over which the cost of non-Federal hydro developments are evaluated. The remaining parts of the costs of power in a Federal project are largely associated with dam and reservoir costs. Because of the anticipated large demand for storage capacity in the long-range future due to increasing population and industrial growth it is reasonable to assume that an increasing share of such storage will be needed for other purposes such as municipal and industrial water supply, water quality control, recreation, etc. For these reasons we are continuing to use the 100 year limit for the time being. It is evident however, that the role of hydro power in a changing power supply picture must be kept under close surveillance in comprehensive river basin planning and development in order that the best possible use can be made of the Nation's water power resources.

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GENERAL APPROACH TO APPRAISAL OF SOLUTIONS

by
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Syllabus. This paper surveys that stage of the planning process which follows the establishment of objectives, determination of needs, and setting of standards and precedes the refinements of specific plans to meet the objectives. Areas which require attention are noted and descriptions given of the usual steps involved in the general appraisal of solutions. No attempt is made to specify "best" procedures. Individuals have strong preferences for procedures which, in their experience, have worked well. Examples of recent techniques are furnished and readily available sources of other procedures are cited.

Introduction. Good planning is not abstract. It cannot be accomplished successfully without objectives, criteria, basic information, consideration of various viewpoints, expertise, judgment, and repetitive refinements. Frequently, past water-resource planning has been deficient in one or more of these aspects. Basic objectives have been confused or drastically limited in scope to one or two purposes. Other objectives have been overlooked, submerged under a "dominant" purpose, or given lip service only as an afterthought. The Administration has failed at times to specify clearly its desires, has been at odds with the agencies' other boss, the Congress, or out of tune with the wishes of large regional segments of the population. Criteria for past studies have varied widely, contradicted each other, reflected wide regional differences, and many would not have been acceptable by current standards. Economic analyses have at times been inconsistent with higher level criteria, neglected external economics and diseconomics, overlooked absolute sizes of gains or costs, improperly measured benefits or costs, included sunk costs, lacked consideration of marginal effects, time preferences, flexibility, proper ranking criteria, and other large and small shortcomings. Deficiencies in basic data, engineering techniques, and reporting procedures have also been accepted. Good planning is seldom a flash of genius but is normally the product of exhaustive, detailed, and repetitive testing, weighing, analyzing, and judging of alternatives.

Knowing what has been "wrong" about previous comprehensive planning does not automatically make it easy to prescribe "the" correct manner of making fine plans acceptable to all interests and conforming to all objectives. In fact there is no single "best" way to appraise solutions or insure identification of the

optimum scale of a project or the best mix of projects and features of the plan to be recommended. One general admonition can be made, however: all planning should be relevent to the basic purposes and to the time period in which it is to be implemented. There are no "ultimate" plans; in fact, there are few areas where it is still possible to have "initial" plans. Plans should be devised for specific areas, conditions and dates and, if possible, permit flexibility to meet changing needs.

General Approach. The preferred method of general approach for appraisal of solutions for water and land resources problems cannot be specifically stated for all river basins. The best approach will vary with the physical circumstances, stage of economic development, needs, existing structures, and the potential demands and the rate of demand accrual. This stage of project formulation requires considerable logic and mature judgment. During this stage, consideration should be given to all possible means for satisfying the wants and problems of the region. It is here that ingenuity in seeking out solutions to provide satisfaction at least cost will be of maximum advantage. All previous bias towards "prime" uses, preferred developments, or the inclination toward structural over nonstructural means must be eradicated. Water and land resources planning is undergoing microscopic examination by many diverse interests. If the engineer is adequately to serve his client and incidently to retain his previous dominant role in this area of planning, he must evidence a willingness to accept economic limitations and values other than those of the functions historically accepted as basic agency purposes. If he doesn't, his plans will not prove satisfying and he will have to relinquish leadership to political scientists, economists, geographers, and other "planners" interested in water resources, as has already happened in the urban planning field.

Available Data. In most areas of the United States, considerable physical data are usually available from previous studies. Many basins have already been partially developed and extensively reported upon. It is assumed that prior to attempting to appraise solutions, the planner will have surveyed all previous reports available, prepared tabulations of data, needs, and capabilities of existing structures in convenient forms and by several different methods, and analyzed the solutions previously proposed to determine their merit for use or modification at this time. The more information the planner has available and the better he has assimulated this information, the more intuitive and better his judgments will be. After thoroughly analyzing the available data, field reconnaissances should be made throughout the basin to examine areas of probable needs and logical uses and to note the sites for structural means of alleviation of problems and of satisfying future needs.

An attempt should be made to quantify needs for all locations, both at present and projected over the period of study analysis, in physical terms to the maximum practicable extent so that they can be related to each other and subjected to engineering analyses.

Organization of Basic Data. After the desires and requests of local interests have been explored, the previous reports reviewed, and the broad objectives of the investigation established, it is necessary to examine further the existing conditions and problems and the performance of existing structures or facilities to establish the base line for further planning. Development and refinement of basic data and relationships will be continued in varying intensities throughout the planning period. There is no inflexible order of procedures to generally appraise possible solutions. However, the following are desirable:

a. Delineation of the planning areas and related markets.

b. Initiation of an economic base study--to establish economic trends, development factors, future needs, and continuing meaningful relationships of outputs and interacting effects. The base study should both precede the general appraisal and be further developed during the screening period along with the development of tentative solutions.

c. Criteria in terms of techniques, procedures, and standards for cost estimating and benefit determination should be available to permit evaluation of all alternatives upon comparable estimating bases at each phase of the screening process.

d. Gaps in basic data should be closed and schedules set for further refining the basic data needed for whatever stage of appraisal is underway.

Steps in Appraisal. The appraisal of solutions involves the following steps: (1) establishment of meaningful standards for development of engineering plans and evaluation of economic effects; (2) inventory of resource development capabilities; (3) preparation of single-purpose methods for meeting the needs for each function; (4) second-stage appraisal and multiple-purpose solutions to refine the elements to be included in the comprehensive plans; and (5) preliminary simulation of the comprehensive plan.

It is believed that the seminar participants will be fairly familiar with most of the policies and standards of the Corps of Engineers and the Federal Government, existing legislative requirements and guide lines, and acceptable ranges of values to be assigned to outputs so that no attempt will be made to list them here.

Constraints on Objectives. While a basic objective of systems design is to maximize net increases in national welfare, existing policies exercise constraints on optimization in several ways, including requiring: (1) geographic distribution or balance for projects; (2) a functional distribution among purposes; (3) higher degrees of flood protection than indicated by economic efficiency to insure against a false sense of security and provide "reasonable" degrees of urban protection; (4) consideration of only "Federal" purposes; and (5) providing against over-emphasis on recreation--by limiting projects to those where benefits from other purposes are equal to 50 percent or more of total project costs and limiting Federal cost to all of the separable cost and up to 25 percent of the total project costs.

Cost Functions. The cost functions desirable for analyzing storage facilities include the following:

1. Capital cost - storage capacity;

2. Capital cost - installed power capacity;

3. Capital cost - recreation (beach, camp, access, boat ramp, trails, sanitation, utility) facility capacity;

4. Capital cost - irrigation (diversion, conveyance, pumping, distribution, drainage), facility capacity;

5. OMR cost - storage capacity;

6. OMR cost - installed power capacity;

7. OMR cost - recreation facility capacity; and

8. OMR cost - irrigation facility capacity.

These relationships can be expressed in graphic terms to extend the usefulness of discreet data. Several levels of development should be projected, particularly where widely varying objectives exist. Methods of analyses by means of graphic techniques are described by Maynard M. Hufschmidt, in Chapter 5, of "Design of Water Resource Systems," by Maass, Hufschmidt, et al, and need not be repeated here.

Benefit Functions. The methods of determining costing and evaluation of alternatives if the subject of another paper. However, for general appraisal purposes and preliminary screening, it is important to have available certain characteristics of the benefit and cost functions to the extent and refinement permitted by the studies available at that time.

Flood-control storage--benefit relationships determined from storage-discharge, stage-damage, discharge-frequency, and damage-frequency relationships, should be related to specific damage centers.

Water-supply benefits, in terms of annual value per c.f.s., for yields developed in different segments of the basin will assist in preliminary screening. The water-supply values have small areal extent and numerous values may be required in order to obtain realism in the screening process.

The evaluation of water-quality control measures should be improved. It is believed wholly unrealistic to evaluate water-quality control features by means which yield values equivalent to those for water supply. Direct measurement of alternatives to dilution, such as added cost of incremental treatment, damages incurred if dilution is not provided, intangible and aesthetic values, and effects upon other uses, such as recreation, are possible and considered more satisfactory than using the cost of alternative single-purpose projects.

Recreational values should vary with the topography, closeness and means access to metropolitan centers, number of similar available facilities, stability and range of recreation pool levels, beach geological factors, and anticipated density of use.

In preliminary screening, irrigation benefits should preferably be limited to direct evaluation and avoid secondary (regional) and tertiary (national) benefits in deciding upon inclusion of irrigation as a purpose. Discontinuities in irrigation benefits for accommodation of pumping and drainage costs should be carefully observed.

Power benefits are frequently expressed in a single value, but careful screening requires capacity and energy values at the site, discounted for transmission effects, and some understanding of the relationship between peaking and base-load values to the particular power system. Examination should be made of the costs of alternatives to pumped storage sites, including, in addition to peaking plants of the conventional type, the market area resources in terms of more efficient baseload installations, peaking steam, gas turbines, and use of standby antiques. Pumped storage must be equated by its effect on total system costs, which includes values for pumping energy and comparisons against other pumped storage sites. Some benefit functions are summarized below:

1. Flood control benefit-storage capacity: (stage - damage; stage - discharge; drainage area - flood discharge; discharge - frequency; damage - frequency; flood discharge - storage capacity);

2. Water supply benefit-storage capacity: (yield - storage capacity; benefit - yield);

3. Power benefit-storage capacity: (elevation - head - storage; yield - storage capacity; yield - head power capacity; power capacity - storage capacity; benefit - power capacity);

4. Recreation benefit-storage capacity: (reservoir area - storage capacity; visitor-days - reservoir area; benefit - visitor-days);

5. Irrigation benefit-storage capacity: (benefit - acre-feet delivered; yield - storage capacity);

6. Navigation benefits-storage capacity: (minimum flow - storage capacity; minimum flow - benefits).

Loss Functions. Not all designs are equally efficient in meeting objectives. Therefore penalties must be assessed against given designs for failing to achieve target outputs set for evaluation of alternatives. The establishment of target outputs is an iterative process but usually can be closely approximated initially by experienced judgment. Realistic loss functions should be established for water supply, power, irrigation, recreation, and navigation functions. However, standards of acceptability of service in these areas should be acknowledged to avoid absurdly extreme loss-function values. As examples, reasonable and infrequent water supply shortages are usually acceptable, as are: infrequent power outages of small percentages, occasional overdraft of recreational pools, and rare flood and ice flow outages on navigation systems.

Inventory of Solutions. Each type of water and associated land need can usually be met by a variety of methods. At this stage of planning, it is necessary to develop all possible solutions with a great deal of imagination. If the most desirable solution is overlooked at this stage, it will probably never get back into consideration and all the refined techniques for optimization will only perfect a second-best solution.

In the remaining portions of this paper, it would be desirable to have some specific basin to consider. The volume of antecedent material required to establish relationships does not permit hypothesizing a sample basin for this paper. Therefore, the treatment will necessarily be general. Possible solutions to consider are listed for different types of problems:

Water supply: curtailed use, pricing, phreatophytic control, cooling towers, ground water development, surface water storage, ground water recharge, diversions from other basins, conversion of saline or brackish water, reclamation of waste waters or limited use for recreation or irrigation, and weather modification.

Water quality: primary, secondary, tertiary, or special treatment, lagooning, dilution, diversion of wastes, drying beds, distillation, and modification of industrial processes to reclaim wastes, use sewage, and correct poor practices.

Flood problem: local measures to various levels of protection, flood-plain zoning, structural modifications to reduce damages, diversion, relocation, and storage in both single- and multiple-purpose reservoirs.

Complementary programs: forest management and land treatment.

Non-structural Alternatives. It should be noted that the inventory of solutions includes many non-structural alternatives.

Alternatives to structural measures for flood protection by reservoirs include flood plain zoning, redevelopment, structural modifications against flood damage, levees, channel improvements, flood warning systems, transbasin and interbasin diversions, and modifications of operating procedures of existing storage reservoirs. Internal alternatives to watersupply storage include recycling of use, pumping, and recharge to ground water, desalinization, restrictions upon rate and time of use by various means, including pricing, and limitations upon types of use during periods of shortages. External alternatives to basin plans for development could include transbasin and interbasin diversions, privately developed facilities for flood protection, water supply, or recreational facilities, State recreational developments, flood risk insurance, and thermal, atomic, pumped storage, or other power devices.

Primary Screening. While it is necessary to examine all feasible means of satisfying the needs and opportunities in a river basin in order to avoid the possibility of overlooking the optimum development, the number of possible solutions and combinations of solutions, and the cost of investigations requires drastic pruning at the earliest possible stage in the formulation of the plans. Duplications, mutually exclusive alternatives, and legal, locational, or structural limitations are effective in reducing the number of alternatives to be considered. Detailed information concerning the outputs and costs for the remaining sites is not introduced until all possible eliminations have been made in order to reduce the cost of the planning effort. One of the common methods in use to

reduce the number of alternatives to be considered at one time is to subdivide the basin into manageable subareas. These subareas are analyzed for maximum tributary or local effects with external manifestations given secondary consideration. The use of judgment, as to the best method for satisfying the needs, is heavily employed in this primary screening. Upper and lower limits of developments for each accepted site, as well as the apparent optimum, should be retained to permit later adjustments in the plan and flexibility to meet changing needs. This is obvious when a slowly developing need can be satisfied by a series of small projects at a lesser total present cost and greater excess of benefits over a higher ranked large project where substantial unused capacity is available for long periods of time. This latter condition works in opposition to the basic purpose for screening and must not be permitted to result in retention of more small projects than are necessary to equal the output of the largest alternative project.

It is again emphasized that throughout the inventory, preliminary, and secondary screening stages every effort has been made to apply consistently uniform criteria for geological, hydrologic, topographic, cost, and benefit analyses to minimize differences in estimates during successive stages of analysis.

General appraisal of solutions is an empirical process which defies analytical analysis or detailed universal systematization.

Examples of General Appraisals. Examples of well-developed processes are contained in the appended excerpts from the unpublished paper on "Water Resource System Design--the Problem of Preliminary Screening," by Maynard M. Hufschmidt, Director of Research, Harvard Water Program, dated April 30, 1963, analyzing four "basin" plans. Seminar participants are also referred to Appendix Q of the report on "Delaware River Basin, New York, New Jersey, Pennsylvania, and Delaware," House Document No. 522, 87th Congress, second session, and the reports of the U. S. Study Commissions Texas and Southeast for widely different methods of appraisal. (Excerpts are on pages 323-328.)

Recent Developments in Planning Techniques. The most recent developments in planning techniques have been in the areas of refining standards and criteria, overall goals, and objectives, and to distinguish among goals where conflicts are likely. The objective of maximum net increase in national welfare is distinguished from national economic growth, income redistribution, and aesthetic or scenic values. Considerable research into water resource problems is underway in the agencies and universities but a great deal more is urgently needed.

Recent examples of revised techniques using more sophisticated mathematical models, gaming techniques, queing theory, simulation processes, linear programming, dynamic programming, random sampling, stochastic processes, response surfaces analyses, and methods of steepest ascents, are described in "Design of Water Resource Systems" and the unpublished papers of the same Harvard Research Group.

A chronological examination of the history of basin planning efforts reveals a continuing refinement in establishment of objectives and improvement of techniques, processes, and methodology which augurs well for acquisition of the tools necessary to accomplish planning objectives in the midst of the ever-increasing complexity of needs, opportunities, and requirements in current and future comprehensive planning problems.

Acknowledgments. As is apparent from the references and example, much of the material utilized in this paper has been drawn from the works, published and unpublished, of the researchers in the Harvard Water Program. These are recommended for their stimulation to thinking about methods of system design. Also utilized was the paper on River Basin Planning in the United States, by Messrs. Eugene W. Weber and Maynard M. Hufschmidt for the United Nations Conference on the Application of Science and Technology for the Benefit of Less Developed Areas, held in Geneva, February 1963, published as Vol. 1, Natural Resources, Energy, Water, and River Basin Development. The report of the panel of consultants to the Bureau of the Budget on "Standards and Criteria for Formulating and Evaluating Federal Water Resource Developments," dated June 30, 1961, is recommended reading for background material on standards and criteria.

1 Incl
Excerpts, pages 323-328

Excerpts from

"WATER RESOURCE SYSTEM DESIGN
THE PROBLEM OF PRELIMINARY SCREENING"

by

Maynard M. Hufschmidt
April 30, 1963

"First-Stage or Rough Screening. Analysis of the screening process used in the four studies shows that all attained a substantial initial reduction in size of the inventory by using a rough screening process to eliminate obviously inferior alternatives, including projects that failed to meet certain overriding criteria.

Delaware study. Initial (as well as second-stage) screening of small, upstream reservoirs was assigned to a joint work group of State and Federal agency representatives. The group first made a detailed study of the basin's problems and needs - including flood control, rural and urban water supply, recreation and fish and wildlife - which this limited type of development might solve. The inventory of 386 sites which had emerged from a detailed map study included 360 new sites and 26 sites that had already been selected for detailed investigation in prior small watershed studies. A general field reconnaissance was then made of all new sites, to check soil conditions topography, channel capacity, land use, existing development, and market potential for outputs. Sixty seven sites were thereby eliminated because of "insufficient storage capabilities, poor foundation conditions, excessive urban developments in the reservoir area, and the location of new highways and utility lines in the reservoir areas which were not indicated on the maps." Detailed office studies were made of the remaining 293 new sites, with particular emphasis on flood control needs; extensive use was made of prior reports and other information from State and local agencies. At the end of the rough screening process the number of survivors stood at 127 new sites.

The second or large-dam part of the Delaware inventory, consisting of 193 major sites, was reduced to 70 sites in first-stage screening by two methods: (1) the numerous duplications and overlappings, arising because all sites in prior reports had been listed, were eliminated by selecting a single site "on the basis of map study;" (2) when "a number of widely scattered dam sites were listed for a tributary with few or no known local problems, the site nearest the mouth of the tributary was generally favored because of the greater size of the drainage area controlled."

Potomac study. In the Potomac study, the initial list of 205 major reservoirs was treated systematically in a way comparable to that for the Delaware inventory; the Potomac analysis was more detailed, however, in that reservoirs were evaluated at three storage capacity levels, instead of at a single level. Map study followed by field reconnaissance was employed in considerable detail, with emphasis on topography, geologic conditions, land use and relocations, design, and cost estimating criteria.

In the screening process the "more favorable reservoir projects" of the initial 205 "were selected for further evaluation consisting of determination of supplemental flow-cost data." The first review eliminated 91 sites for the following reasons:

(a) High cost for small storage
(b) Unsatisfactory geology
(c) Alternate is more economical
(d) Excessive cost
(e) Too steep for economical storage
(f) Poor geology and severe relocations
(g) Extensive urban development
(h) Topographic limitations
(i) Insufficient watershed
(j) Lack of need

A second review of the remaining 114 sites eliminated 45 more for the following reasons:

(a) High cost of storage
(b) Smaller, more expensive than alternate
(c) No local needs
(d) Extensive relocations, poor geology

Upper Snake study. The Upper Snake master listing of over 500 potential sites was reduced to 80 sites by screening based largely on physical considerations. As stated in the report, "each project was weighed in its relation to the other projects, with respect to optimum use of the resources involved, in accordance with long-range needs, in relation to problems it might create, according to other land and water-resource uses and needs, and with respect to a set of broad criteria adopted for the basin investigation. Alternatives were evaluated and situations where developments were found mutually exclusive were analyzed." The reasons stated for eliminating 433 sites were as follows:

(a)	In Yellowstone (or Teton) National Park	17
(b)	High unit cost	39
(c)	Geology unfavorable (or questionable)	69
(d)	Alternate site preferable	139
(e)	Right-of-way problem	37
(f)	Runoff inadequate (or already controlled, or diverted)	79

(g)	Would inundate...	9
(h)	Superseded by...	9
(i)	Water rights problems	8
(j)	All other reasons	27

Texas Rivers study. The U. S. Study Commission-Texas reduced its inventory of 238 reservoir sites to a list of 74 sites to be given future consideration. The report gives the basis for screening as follows: "In the formulation of plans...consideration was given to the many dam sites in the interest of satisfying the requirements for 2010 municipal and industrial water use, irrigation, power potentialities, and flood control. The key factors in the selection of the specific sites to be included in project formulation were: location of the 2010 water requirements, yield of the sites in the general proximity of needs, and the cost of the storage facilities to develop the watershed yields." No other clearly-defined selection factors were spelled out, but there is general reference to reasons for rejection such as "site to be inundated by present construction," "site limitations," "yield less than demand," "no significant water requirements," "requirements could be supplied by another site," "no single site capable of supplying yield on the basis of cost figures."

Some conclusions. These experiences with first-stage screening suggest one generalization: the measures used to rule out projects are so gross, and the resulting choices so obvious, that there is no place at this stage for use of systems analysis or, indeed, of any refined choice techniques. One caution is in order, however. It may be tempting at this stage to screen out entire classes of alternatives on the basis of broad policy, or administrative or institutional criteria. To the extent that these criteria flow from the design objectives given to the system planners, their use in screening is appropriate. For example, an objective relating to maintaining amenities and historical values may be the basis for a criterion that no reservoir development be allowed in national parks. However, to the extent that screening criteria are not grounded on policy objectives, but are a matter of administrative convenience, their use as tools for screening is inappropriate. Ruling out dams in national parks may be a proper reflection of a policy objective, whereas ruling out flood damage prevention measures such as flood plain zoning, structural modifications, and area redevelopment because they are beyond the scope of authority of the planning agency, may be little more than a matter of administrative convenience.

Aside from these few general comments, we have nothing to suggest here on first-stage screening: of necessity, it is a highly empirical process not subject to analytical treatment and detailed prescription.

Second-Stage Screening

In the three studies examined that involved second-stage screening, le alternatives were analyzed by planners in much more detail than in le first stage, although still not to the degree of refinement required or final plan selection. In second-stage screening, need arises for a onsiderable amount of physical and economic data on the individual rojects; in each of the cases examined, this turned out to be a task f fairly large magnitude.

Delaware study. Second-stage screening for small dams in the Dela- are began with the reduced 127-site list. A second, detailed field nvestigation of these sites on an individual basis, again taking account f flood control considerations only, sought to perfect the data of flood ontrol needs, damage estimates, and costs of providing protection. The riterion established seems to have been a benefit-cost ratio, as 88 small ams were discarded because they did not produce benefits sufficient to over costs. The remaining 39 small dams were recommended in the final lan.

Second-stage screening for the large dams in the Delaware began ith the reduced 70-site list. As a first step, 20 single-purpose run- f-river power sites were set aside for separate analysis in hydroelectric tudies, redevelopment of two existing reservoirs were set aside because lternative undeveloped sites were present in the inventory, and the emaining 48 sites were subjected to an "order-of-merit" cost-worth ppraisal, in which the performance of each site was examined independently, nd sites were ranked on the basis of a "cost-worth" ratio. No systems nalysis was involved. The ranking influenced the selection of five (later xpanded to nine) basic plans, each containing about 25 sites, from which he plan was selected as superior. From further analysis and refinement f this plan, and the addition of two enlargements to existing dams not reviously considered, there evolved the final 19-dam plan recommended the Corps' Delaware report.

Potomac study. Second-stage screening in the Potomac is believed o have begun with the reduced list of 69 sites obtained from earlier eviews of the total potential of 205 sites. The 69 sites were subjected o a rough type of systems analysis in which cost of storage or yield in erms of water supply played a dominant role. Successive trial solutions nd re-examinations of core elements of the plan were made, matching torage reservoirs with needs for various purposes by a procedure which tarted with the storage sites farthest upstream and continued downstream. his screening process yielded a core group of projects which was later bjected to detailed engineering and economic analysis that led to the reparation of four basic plans from which a final choice could be made.

Upper Snake study. Second-stage screening in the Upper Snake basin egan with the reduced list of 80 sites, from which a final 46-dam list nerged. There is little evidence in the report of any systematic screen- ng procedure which can be identified as distinct from detailed and final- ype engineering and economic analysis. It is apparent that narrowing the

field of contenders from 80 to the 46 most promising sites proceeded with relatively detailed analyses. No basin-wide system analysis was applied at this stage, although groups of closely-related reservoirs were studied as sub-systems. It was made clear in the report of the study that the 46-site list did not comprise a final plan.

Texas studies. The U.S. Study Commission-Texas did not carry its work beyond the first-stage screening that led to the list of 74 sites.

Suggestions for Improvement in Second-Stage Screening

This brief summary of the preliminary screening process in action serves as an introduction to discussion of ways and means of establishing a more systematic approach to the problem, which would include the use of systems analysis.

Applying systems analysis. Before we turned to systems analysis techniques for preliminary screening, we experimented with refining the "order-of-merit" approach of ranking individual projects used by the Corps in the Delaware study.

In his paper of December 7, 1962, on a preliminary screening approach Wilkinson suggested that the "optimal" scale of development of each project considered alone be determined before projects are ranked. The "optimal" scale is found by a rough incremental benefit-cost analysis, using preliminary cost-input, input-output and output-benefit functions to examine various scales of development. From the set of ranked projects, a subset of high-ranking projects is selected for further detailed analysis.

This approach carries selection by ranking of individual projects to its logical extreme. Comparisons are made among projects where each is presented in its most favorable light. There is no possibility, therefore, of projects being improperly ranked because some projects were developed to inefficient levels while others were at more nearly optimal levels.

The basic weakness of the "order-of-merit" approach, whether in its original or revised form, is its failure to apply systems analysis where systems analysis is clearly applicable. This major limitation serves to restrict application of methods like "order-of-merit" to special cases where physical and economic links between individual projects are weak.

Believing, then, that a screening of alternatives requires that structures be evaluated by their performance in a system rather than in isolation, we suggest tentatively three alternative methods of systems analysis. Our plan is to experiment with these methods, using Delaware basin data, in the hope that one or more of them may lead to a workable strategy for second-stage screening.

1. A Simplified Linear Program. This method, suggested by Professor Dorfman, would identify the better alternatives by solving a large number of simple linear programming problems. Each solution would identify the least-cost mix of alternatives to meet specified demands for purposes such as water supply, energy, recreation and flood control. The mix of demands would be changed many times - each demand mix presenting a separate linear programming problem. From these many solutions, one could select the superior alternatives as those that showed up in many if not most solutions; conversely, inferior alternatives would appear in few if any.

Water supply and energy demands or targets would be set in terms of quantities to be supplied; recreation and flood control demands would be set as constraints that could not be violated. Of necessity, simplified storage-yield and storage-flood control effects would be used. A major problem to be resolved relates to handling storage-yield relationships of reservoirs in series.

2. A Linear Programming Solution Involving Stochastic Treatment of Streamflows. This method, suggested by Professor Thomas, would be applicable only where the number of alternatives was small, or where the system could be divided into workable segments. In essence, it would, under simplified conditions, solve for the optimal mix of reservoirs and outputs - optimal being defined as maximum net benefits. Simplified cost and benefit functions would be used. While storage-yield functions based on deterministic, mass curve-type analysis would be used (as in the Dorfman model), a stochastic element would be added to the problem as part of input. The solution to the linear-programming problem would thus take account of stochastic streamflow.

3. Rough simulation of the system. This method, proposed by Dr. Fiering and currently being developed by him, involves a standard computer program, for simulating the operation of a single reservoir, which is combined with a simplified simulation program for the entire system. In this way the performance of various system alternatives can be evaluated. The program will be written to handle, admittedly in oversimplified form, any configuration of time periods, target outputs in terms of flow requirements, and reservoir volume constraints - say for flood control and recreation.

An associated feature is a sampling procedure involving random sampling plus a steepest-ascent program, to rule out inferior alternatives and converge quickly on superior ones."

ENGINEERING ASPECTS OF APPRAISAL OF SOLUTIONS

by
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1. In appraising alternative solutions in the development of basin plans it is important that we take into account, insofar as we can, all factors which we can evaluate in some fashion - engineering, economic, social and political - using the latter term in its highest sense - and that we include both tangible and intangible aspects. Since it is never possible to establish a true common denominator for all of these factors, it is also necessa y that we apply a generous portion of sound judgement and common sense in arriving at our final choice.

2. In appraising alternative solutions from the engineering point of view we need to take into account such factors as:

a. Whether the alternative solutions are in fact comparable. In some cases alternative solutions which are apparently equivalent do not in fact produce the same results. One project may be inherently better from an engineering point of view, it may have a longer life, or the benefit which it achieves may be more certain.

b. Whether some solutions offer greater flexibility than others from the point of view of potential future modification of the project purposes to suit possible future needs. For example, a flood control reservoir project may offer greater feasibility for possible future multiple purpose use than an alternative local protection project.

c. Whether some solutions include projects which are more or less susceptible to unforeseen problems and consequent increases in cost. For example, dam sites in one area may have foundation problems of a serious nature which are not too susceptible to advance evaluation based on limited explorations.

d. Whether alternatives within the project have been fully considered as discussed below.

3. In comparing alternative projects, one of the following procedures is customarily used:

a. Compare <u>costs</u> of alternative projects designed to provide essentially equivalent benefits, where differences in side effects of the projects are not of major significance; or

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b. Compare benefits to be afforded by the alternative projects of essentially equivalent costs, where differences in side effects are not of major significance; or

c. Compare benefits and costs of one project proposal with benefits and costs of practicable alternatives, where differences in features of realistically designed alternative projects result in substantial differences in benefits, costs or side effects.

(The term "side effects" refers to differences in certain risks or differences in intangible benefits or adverse effects that cannot be estimated satisfactorily in monetary terms.)

4. It is particularly important that comparisons between "alternatives" be based on realistic alternatives. That is, we should not assume "alternative" projects that we are reasonably certain could not be built under prevailing or anticipated circumstances. We should not adopt as a theoretical alternative any proposal that the Chief of Engineers would not be willing to support; this does not preclude appropriate discussions of possibilities of alternatives, with reasons for not considering these in detailed comparisons. (The East St. Louis levee case is a good illustration pertaining to above comment. It was finally decided by the Chief of Engineers that reservoir flood control benefits would be based on consideration of levee overtopping damages during extreme floods, because the Chief had previously concluded that levee raises were not practicable even though such raises were theoretically feasible.)

5. In engineering appraisal of solutions, comparative estimates of costs should be made for alternative types of projects or combinations thereof that will meet planned objectives. For instance, appraisal of possible solutions to a flooding problem may require preliminary design and cost estimates for alternative flood control reservoir and channel improvement projects to determine the most economical combination of dam and channel sizes. Sufficient investigations need to be made of the alternative features of individual projects to establish reasonable comparative estimates of costs. For instance, the erosive nature of rock should be established at spillway, diversion tunnel and stilling basin sites to determine extent of spillway or tunnel lining and type of energy dissipator. Also, velocities in flood channels should be determined with reasonable accuracy to establish the need for bank protection or concrete lining.

6. Engineering appraisal of solutions should consider the ultimate development of the power potential of a project, particularly if step development of a basin is involved. If part or all of the power facilities are to be deferred, studies should be made to define the costs and the provisions that are to be made initially for future power facilities. Pumped storage studies should cover the availability and cost of off-peak energy. For conventional and pumped storage

power facilities, the cost associated with the most economical source of power should be considered as an alternative solution to providing power facilities at projects.

7. In general, any plan included for regulation or control of river flows, regardless of purpose, should be subjected to an appropriate series of hypothetical operation studies. As one example, the capabilities of flood control projects should be tested by routing a series of floods exceeding the design capacities, particularly where a relatively low degree of protection is proposed. In some cases, these analyses may show that for a modest increase in cost the degree of protection can be raised significantly and extreme hazards greatly reduced.

ECONOMIC ASPECTS OF APPRAISALS OF SOLUTIONS

by
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Since this paper is part of a larger subject concerned generally with the appraisal of solutions to water and related land resource development problems, it appears appropriate by way of introduction to consider briefly the nature of the problems requiring solution. Water resource development is a means of providing goods and services to meet the needs of an expanding economy. Such development is justified if it meets the need for goods and services more efficiently than would otherwise be possible. Water resource development is not an end in itself. It is not something to be done merely for the sake of doing. If it were true that water resource development were an end justified in and for itself, there would, of course, be no problem of selection from among alternative solutions nor, for that matter, for planning in any form since it would be obviously desirable to undertake all developments immediately.

The other major point to be made by way of introduction is that there are many possible courses of action, some in the public sphere and some in the private sector, for accomplishing the needed increase in goods and services. (It is worth noting that under our prevailing social and political system there is no apriori presumption of advantage for action in the public sector). It is the fact of this multiplicity of possible courses of action which gives rise to the need for planning. For if only one course of action were open to us, the answer would be predetermined. In the words of the Green Book, "In the broad sense, the process of project and program formulation from beginning to end is largely a matter of weighing alternatives."

The first requirement for an appraisal of the economic aspects of alternative solutions to a problem is knowledge and understanding of their performance in physical terms. How does the protection of an area from flooding provided by a reservoir compare with the protection provided by a flood wall or levee in terms of the reduction in stages and frequency of flooding, and in the area flooded at various stages? How much power will a hydro plant generate and what are its characteristics in meeting load requirements? How much and what quality assured water will a reservoir yield for municipal and industrial use and for low flow augumentation? How large and what will be the other significant features of the permanent pool in terms of recreational use? These are examples of the kinds of data on physical performance that are needed for the economic appraisal of alternative solutions.

Comparison of the relative economic desirability of various alternatives requires a quantification of their salient beneficial and adverse

ffects in terms of an acceptable common denominator. In our free and ighly competitive society, the market mechanism serves to bring into alance scarce resources with product demands. Under these conditions, arket prices provide a measure of the exchange values, expressed in ommon monetary terms, that both producers and consumers attach to goods nd services. Thus, for most project effects, monetary values expressed n market prices provide an acceptable yardstick. For a limited number f additional effects such as, for example, recreational use, for which arket prices are largely lacking, it may be possible through demand urve analyses or other techniques to derive simulated market prices which rovide a fair measure of comparability. Some progress is being made long these lines in studies by Resources For The Future and others. How-ver, there are and probably always will be significant residual intangible ffects which defy expression in moneatry terms such as security of human ife, preservation of species, and scenic values. These should be described, s fully as possible in quantitative terms, to provide the best possible asis for judging their importance in choosing among alternatives. Where he realization of intangible benefits necessitates an expenditure solely or this purpose, the cost may be taken as a measure of the minimum value ssigned to these benefits.

Differences in the pattern of the time streams of benefits and costs or various alternatives must also be reconciled. In part this may be ccomplished through conversion of all benefits and costs to a common time asis. For this purpose we are now using a single interest rate, as pro-ided in S. D. 97. This rate is computed as the average rate of interest ayable by the U. S. Treasury on outstanding long-term securities of the nited States. Although there is now quite broad acceptance of the single nterest rate concept, there is lacking a broad consensus among authorities oncerning the validity of the basis in S. D. 97 for determining the rate or use in benefit-cost comparisons. Further studies of the matter are nder way.

Special aspects of the problem of appraising solutions concern the omparison of alternatives in the public sector and in the private sector s, for example, in comparing a commercial navigation project with lternative modes of transport, e.g., a railroad, or in comparing a ederal hydroelectric project with a private thermal plant. SD 97 pro-ides that the evaluation of alternatives shall be made in comparable erms. In order to give effect to the broad public viewpoint in these nstances, it is considered appropriate that the project rates for nterest, taxes, etc., should be applied to the private project rather han vice versa. In essence, this has the effect of eliminating dif-erences of a financial or accounting nature and reducing the appraisal o a comparison of the actual use of resources valued in comparable erms in each alternative solution.

The requirement that a uniform yardstick shall be used in the appraisal f alternative solutions applies to several other aspects of the problem ncluding period of analysis, taxes, price levels, secondary benefits,

amortization and salvage. These matters are not discussed in this paper as they are covered in considerable detail in the Green Book and in S. D. 97. Neither has this paper touched on the many complex conceptual and procedural problems that face the planner in combining the solutions to specific problems in order to come out with the system that is "best" in terms of all of the needs and purposes, since these matters are the subject of other seminar papers.

COSTING AND EVALUATION OF ALTERNATIVES

by

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1. The specification of costs and benefits is a vital part of each stage of the planning process of a water resources system. It plays an important role from the earliest stages of plan inception, and preliminary screening, thru final plan formulation and economic justification, to the final stages of cost allocation and cost sharing. At each of these stages the decisions made and the results obtained can be no sounder than the soundness of the benefit and cost data on which they are based. Indeed the goal of plan formulation is often stated as the maximization of net benefits or the difference between benefits and costs. It is the purpose of this paper to consider briefly the economic basis of evaluation of the inputs and outputs of a water resources system, some of the measurement and other problems involved in such evaluation, and for certain specific purposes some recent developments affecting their evaluation.

2. Someone once described economics as the science of choosing from among all practical alternatives the one that is best. Surely the choice is impossible unless the costs and effects of the several alternatives can be expressed in somewhat comparable terms. Thus the objective is to express the real values in comparable terms. It is only then that we can say what the difference is for two alternatives in the values foregone and the values derived. This economic costing and evaluation of alternatives involves many complex problems of measurement. They involve first of all measurement of the quantitites of both the goods and services that go into the project and the goods and services that are produced by the project. Goods and services are used here in their broadest sense. The measurement of these resources and products is made difficult by the fact that some cannot be reduced to physical or even measurable quantities such as cubic yards, pounds, man-hours, kw-hours, etc. The problem of reducing the effects of water quality control to standard units of measurement is a good example of the difficulties that arise in attempting to scale, in this case, the output of a water resource project, in meaningful units of measurement.

3. However, although the measurement of some of the inputs or outputs of a water resources project present serious obstacles this is no license to lower our standards of measurement. Nor because of difficulty of measurement can we ignore or minimize the importance

of a particular effect. Even if it is practically immeasurable we should describe it as accurately as possible and circumscribe its magnitude at least qualitatively if not quantitatively. We have the definite responsibility to make these important measurements as precisely as we know how.

4. A further difficulty arises from the necessity to express the diverse inputs and outputs in comparable terms. The only common measuring device is of course dollars. With a perfectly competitive economy and consumer sovereignty, the value of goods and services is measured by the consumers willingness to pay for them. With such a system prices play a vital role. Not only are they simple measures of value but they are the levers that operate the market mechanism and allocate the available resources in accordance with the consumers demands. In the competitive model prices perform these roles without friction. As a result, the demands of the consumers are satisfied at the lowest possible costs, the factors of production are rewarded in accordance with their contribution to the production process and the whole economic process is conducted with the efficient use of the nation's resources. The important thing to note is that with such a model prices are accurate measures of real values. Unfortunately, there are several reasons why this model does not accurately represent the working of our economy. Even in the private sector of the economy, and more particularly in the public sector, there are many departures from the perfectly competitive model.

a. First of all some of the goods and services associated with water resources development are collective goods and not marketable. Flood control is an example. We don't really know what flood control is actually worth to an individual since it is rarely marketed.

b. Certain costs or effects are of an intangible nature. There is no way to evaluate in monetary terms the cost of a scenic resource flooded out by a reservoir or the value of providing the esthetic good of a clean stream.

c. There is a lack of market data for certain products or services. Although public outdoor recreation is a marketable service such services are usually provided in whole or in part at public expense.

d. Certain sectors of the economy are regulated in the public interest and the market mechanism does not function freely in these areas. Transportation is an example and I will have more to say about the measures of value in this sector later on.

e. Another factor of growing importance is the restraint placed on the free operation of the market by the concentration of economic power in larger and larger units. An example is the presence of prices set administratively rather than by the operation of the market. As one author recently stated "In a large part of industry the market is not equating supply and demand through a flexible price

mechanism but is bringing an adjustment of production to demand at administratively determined prices." (1)

5. The result of all these deficiencies is that prices may not be the accurate representations of value that they are in a perfectly competitive world. Because the market mechanism does not furnish market prices for all the purposes and products of water resources development, or furnishes prices that do not represent real values, we are forced in some cases to adopt other means so that we can measure the effects of such systems on a reasonably comparable basis. One solution that comes to mind is that, when prices are not available or do not adequately measure real values, we could use costs in lieu of prices. We of course do use costs in many cases. There are two situations where this applies. The first is where we would use imputed costs as the measure of value for the project goods or services. This is essentially what we do in estimating flood damages - we estimate what it would cost to restore or replace damaged or lost property. On a somewhat more elaborate scale this is essentially what we do when we estimate, for example, the value of hydroelectric energy as the alternative cost of energy from an equivalent steam plant. This method of estimating value by means of alternative costs is acceptable if used properly. It it is not used carefully it can lead us far afield. There are three conditions that must be satisfied if the method of alternative costs is to serve as a measure of value. First there must be a demand for the goods or services produced. Secondly, the alternative chosen must be a real alternative way of satisfying the demand. And finally the alternative chosen should be the lowest cost alternative way of satisfying the demand. For example, consider the case of evaluating the worth of municipal and industrial water supply in a multiple-purpose project. Let us assume that the demand for the water has been definitely established. Now, although the easiest way of estimating the value may be a single-purpose water supply reservoir at the same site as the multiple-purpose reservoir under study, there may be a site on a tributary that would serve equally well at a lower cost and would probably be the site chosen if local interests were to develop their own supply. Or the cost of either reservoir may grossly overstate the value of the water if construction of a lower cost well field is a feasible alternative. This example is not too far fetched as we have had in the past survey reports where water supply was evaluated by a single-purpose reservoir at the same site as the multiple-purpose reservoir without full consideration of the availability of other alternatives.

6. If a particular service is an intangible that cannot be reduced to monetary terms by imputed costs or if there is no real alternative that might be costed as a measure of value then we are left with the task of describing the service and its effects and circumscribing their magnitude in qualitative terms at least. Very often we could at least show what the intangible is costing. For example, we often provide a higher degree of flood protection for an

(1) Gardiner C. Means "The Corporate Revolution in America" 1962.

urban area than is indicated on the basis of tangible benefits. This is because of the threat to life, health and security of the people in the area. We could easily show the cost of these intangible considerations by showing the cost of both the recommended plan and the plan based on tangible benefits. The difference is the cost of the intangible considerations.

7. One of the real problems of costing and evaluation of alternatives is tracing out or defining over the project life the effects of each alternative, whether beneficial or detrimental. This process of tracing out must be performed twice - once with the project and once without the project in order to estimate the true differential effect attributable to the project. This requires imagination and ingenuity no less than does the plan formulation process itself. Unless all of the effects that are significant are weighed in the balance scales of costs and benefits we cannot of course produce a true economic solution. It may be extremely difficult to estimate the changes in the stream regimen below a reservoir, or the shore changes caused by a harbor entrance channel but the differences in these items with and without the project are economic gains or losses attributable to the project. There are one or two other things that are significant in connection with the "with and without"principle. First of all "with and without" is not the same as "before and after." A simple illustration will make this clear. In a fairly recent report it was esimated that land values in the flood plain as of the first year of the project were so much and that these would increase over the life of the project due to higher land uses. The difference, properly discounted, was attributed to the project. This is a before and after comparison not a with and without comparison. It was quite clearly indicated in the same report that even without the project a change to higher land use, though at a lower rate, would undoubtedly take place. Obviously the real benefit attributable to the project is represented by the difference between these two profiles of development and not between the profile with the project and the initial value. Unless the with and without principle is carefully considered we will find ourselves attributing to the project beneficial effects that come about from normal growth, from technological improvements or other developments unrelated to the project itself.

8. The other point is that the incidence of the costs of the detrimental effects of a project has no bearing on the economic answer. Although the costs of poorer drainage caused by a project may, for example, accrue to some unsuspecting farmer rather remote from the project, and not the Federal Government, these costs are part of the true economic cost of the project and should be estimated to the best of our ability. Even if the Federal Government is shielded legally from responsibility for such damages they still remain a real economic charge against the project. The hold and save clause does not hold and save such detriments from inclusion in the analysis to develop the true economics of the project.

9. Another principle of economic analysis that we sometimes lose sight of is the so-called principle of sunk costs. Once funds have been committed to the construction of a project the only costs that are still subject to our decisions are future maintenance and operation costs. At the time of planning the project we may have expected a stream of benefits sufficient to cover all costs. Suppose after construction we find that the benefits are not sufficient to cover all costs including the interest, and amortization of the original investment and the maintenance and operation of the project. It would be obviously wrong to close down the project for this reason. That would not eliminate the charges on the investment. If the future benefits are more than enough to pay for the maintenance and operation charges, it would pay us to maintain the project. By so doing we minimize our losses. This is a rather obvious example. One that is not so obvious occurs sometimes with respect to harbor development. Suppose we are in the fortunate position of planning a system of harbors to serve a particular trade. Suppose it involves one shipping and two receiving harbors. The transportation savings on the entire traffic movement must be sufficient to justify all three harbors and must be allocated among them on some logical basis. Suppose now that the shipping harbor and the first of the receiving harbors have been built, but when we come to build the second receiving harbor we find that the portion of the transportation saving previously allocated to this harbor is no longer sufficient to justify its construction. In such a case it would be proper to credit the full transportation savings on its commerce to the harbor in question and reserve no part of these savings for the shipping harbor that is already built except possibly a proportionate contribution to its maintenance. If the harbor in question is justified on this basis it should be constructed. What we are doing is divorcing ourselves from the effects of previous decisions and basing our decisions now solely on the future costs and benefits that are still subject to that decision. This gives us the proper economic answer. As Grant and Ireson (2) succinctly put it "in choosing between alternatives for the future the important question is not, 'Where have we been?' but rather, 'Where do we go from here?'."

10. Finally it should be pointed out that in measuring the effects of a project the costs and benefits should be the net valves attributable to the project. The benefits of bringing an acre of land into production are the increased returns to the farmer net of the associated costs incurred to bring the land into production. Similarly, the costs chargeable to the project if it should cause an acre of land to be taken out of production are the decreased returns to the farmer net of the costs of production avoided. This same principle applies in other areas of benefit and cost evaluation. In many cases this requires careful consideration to assure that we are comparing like things and that the end products are the net benefits

(2) "Principles of Engineering Economy" 4th Ed. 1960 p. 290.

from the national viewpoint that we are trying to maximize. The problem of netness is of general concern, occurs in all economic measurements, and must not be overlooked.

11. Risk and uncertainty are inherent in costing and evaluating alternatives. Much has been written on the subject of decision making under conditions of uncertainty. The final sentence by Professor Dorfman in his discussion of the subject summarizes the situation very well: (3) "At present, however, the problem of uncertainty is clouded with uncertainty." I do think we need to consider this subject and to get others to realize the risk and uncertainty in water resource development. It is a lack of appreciation of these matters that have tended to surround our B/C ratios with an aura of precision that is not warranted. There are three principal circumstances that give rise to risk and uncertainty in evaluating water resources developments. First since the benefits accrue in the distant future we have the uncertainty that is common to all investments that depend on remote realization of returns. We also have the uncertainty due to technological innovation that might render a project economically obsolete although it is perfectly sound physically. And finally, in the field of water resources we have the unique risk due to the random nature of water occurrence. The divergence of opinion on the allowance that should be made for risk and uncertainty covers an extremely wide range. One aspect that merits consideration is the substantial difference in the risk and uncertainty inherent in investments in water resources projects and those in the private sector of the economy. The former generally represent relatively low risk investments. The products and services of water resources development go to satisfy the nation's most basic needs for domestic and industrial water, food, fibre, energy, transportation, recreation, and protection from the ravages of flood and drought. These goods and services are so basic to all human activities that the projects that furnish them are not as susceptible to changing consumer preferences and to technologic and economic obsolescence as projects serving less basic demands. They are not comparable in riskiness, for example, with ventures to satisfy the nation's demand for hula hoops. Also, many people do not take into account the tremendous flexibility of most water resource projects. Reservoirs that may have been planned and justified for a particular use are readily adaptable to serve the whole spectrum of water demands. This also tends to reduce the risk inherent in a particular project.

12. Methods too numerous to discuss here have been suggested for dealing with the problem of risk and uncertainty in the planning of water resources projects. Professor Dorfman describes some of them. The simplest would be to make an allowance for risk in the discount factor. Professor Thomas suggests that this be related to the standard deviation of the probability distribution of the net returns. Thus projects whose benefits had a high degree of variability would be penalized accordingly. All of these methods become very complex in application.

(3) Maass et al. "Design of Water Resources Systems" p. 158.

Also they are limited to those areas where the probability distribution of the effects of a water resources project can be estimated. While this may be possible in estimating the risks inherent in hydrologic phenomena it is extremely difficult to account for the economic and technological uncertainties to which our planning is subject. There are two practical things that can be done as hedges against risk and uncertainty. The first is to make our estimates sound and conservative, and the second is to limit the period of analysis to no more than 50 years for those projects that are not flexible and are most likely to be affected by economic and technologic changes.

13. Some economists argue that people collectively have a different time perspective than they do as individuals. Acting as an individual a person is primarily concerned with his more immediate or short term welfare and that of his family, while acting collectively he takes a broader, more altruistic, and longer view of things. This appears to me to have considerable merit. Certainly, for example, a generation or two is a very short time in the life of a nation. A principal component of the discount factor is therefore a factor representing the social time preference of money which includes the social evaluation of opportunities foregone. Both of these concepts, social time preference and an allowance for risk and uncertainty must be accounted for in our discounting of future costs and benefits. However, the time preference should reflect the time horizon of society collectively and the allowance for risk should reflect the comparatively low risk involved in the water resources field.

14. As a practical matter we will continue to use the rate, currently 2-7/8 percent, prescribed by the BOB. This approximates a no-risk rate since it is really based on the expected financial solvency of the Federal Government. This rate may approximate the low rate indicated from the viewpoint of social time preference, but it would appear that a factor should be added to it to account for the risk inherent in planning and developing water resources projects. As indicated the risk component would be relatively small for this essentially low risk area. It would probably take considerable time to effect any change in our present procedures with respect to discount rates. And the change will probably have to be made on the basis of judgment as a result of the public consensus that culminates in the legislative and executive branches of the Federal Government. A study of this matter has been undertaken under the sponsorship of Resources for the Future. Professor Kenneth Arrow of the University of California has been selected to make the study and it is hoped that this study will shed some much needed light on the subject.

15. I am going to talk briefly now of certain specific types of benefits - principally those affected by recent changes in policy.

16. Redevelopment benefits. The first of these are the so-called redevelopment benefits. Section V A(3) of S.D. 97 provides that "formulation and evaluation of plans or alternative plans shall be accomplished in such a way as to permit timely application of standards to conditions of * * * * * chronic and persistent unemployment or underemployment in designated areas," and in such cases "project benefits shall be considered as increased by the value of the labor and other resources required for project construction, and expected to be used in project operation, project maintenance, and added area employment during the life of the project, to the extent that such labor and other resources would--in the absence of the project--be unutilized or underutilized. Such benefits should be clearly identified as redevelopment benefits for the purposes of cost allocation, cost-sharing procedures, and to indicate their significance for project justification." The following discussion deals primarily with labor resources but a similar approach would apply to other unutilized or underutilized resources.

17. There are three categories of benefits mentioned - those in connection with project construction, those related to project maintenance and operation and added area employment. It is necessary, I believe, to make a distinction between the first two categories and the last one. The first two represent primary benefits while the third class is very likely to represent secondary benefits. If part of the labor or other resources employed in the construction or maintenance of a project would be unemployed or underemployed in the absence of the project the real economic value of this labor is zero or very low. Without the project its contribution to the national product would be little or nothing. This matter is discussed at some length by Eckstein. (4) Therefore, in estimating the cost of the project such resources should be evaluated accordingly. Actually to avoid budget complications it is better to consider these as added benefits rather than reduced costs. The increase in wages paid for such labor would be a measure of the benefit. In making such an estimate, we need to know first of all the total on-site labor required - broken down into unskilled, semiskilled and skilled categories, the amount of unemployed labor available in the area in each category; and the amount that is likely to be employed on the project. It is particularly important to consider the special skills required by the project in relation to skills of the unemployed labor available. Also, it would be unrealistic to consider that resources unemployed at the present time would remain unemployed indefinitely. It would be more reasonable to assume that these areas of high unemployment would gradually, over a period of 10 or 20 years, approach full employment. The benefits claimed should be adjusted accordingly.

18. The third category of benefits namely those due to employment of otherwise unemployed labor in plants attracted to the area by a water resources project are different from the first two categories of benefits for two reasons. First, they are very likely to represent transfers from one region to another. Secondly, the employment of this class

(4) Eckstein, "Water-Resource Development."

of labor requires investments in plant facilities in addition to the investment in the project. The result of the first difference is that the employment benefits may be entirely regional or local in nature with no net benefits to the nation as a whole. The result of the second difference is that the estimate of the benefits must recognize that these benefits are due only in part to the water resources project and in part to the investments in plant facilities. Secondary benefits also arise from the employment generated in service type industries because of the increased income in the region. These may be estimated by application of a multiplier to the employment benefits due to construction, maintenance and operation of the project and to the induced employment benefits in plants attracted to the area. Since the service industries in a redevelopment area are likely to have excess capacity the multiplier should be moderate. Mr. Roterus is his discussion of the role of ARA (pages 135-142) suggested that a multiplier of from 0.4 to 0.6 would be reasonable. These benefits should also be discounted assuming a gradual decline to zero in 10 or 20 years.

19. It follows from the above discussion that the benefits due to employment of unemployed resources in the construction and maintenance of the project are net gains to the nation and should be included in the economic justification of the project. The third class of benefits are secondary and likely to represent no net gain from the national viewpoint. It is not entirely clear from S.D. 97 how these secondary benefits are to be handled. Since they are discussed separately from secondary benefits and since no distinction is made between direct employment on the construction and maintenance of the project, and employment in plants attracted to the area by the project, it might be inferred that the intent was to consider them on a par with primary benefits. On the other hand, the discussion of secondary benefits makes no exception for treatment of such secondary employment benefits. Therefore it seems to me that the regional or area employment benefits due to employment of labor that would otherwise be unemployed should be carefully estimated and shown separately from the primary benefits. It should be clearly indicated that they are benefits due to added area employment. If they are considered significant they could be included in a separate B/C ratio as suggested in S.D. 97. The weight given them in the final recommendation would be a matter of judgment. It certainly seems clear from the document that it was intended that they be given more weight than the usual type of secondary benefits. If they are shown separately and if the consideration given them in the final recommendation is spelled out this will meet the document provision "to indicate their significance for project justification."

20. Navigation benefits. One of the areas mentioned where prices may not serve as accurate measures of value was in the regulated sectors of the economy. The most important such area related to water resources development is in the field of transportation. Our inland navigation projects compete directly with other modes of transportation. In the past the benefits accruing to new, or extensions of existing waterways have been estimated on the basis of a comparison between rates (prices) of land transportation and constructed

charges for barge transportation. Unfortunately, transportation pricing, particularly for railroads, departs very markedly from competitive pricing so that the prices charged are not true measures of the value of the goods and services that are required to provide the transportation service. The Green Book, S. D. 97, and the Engineering Manual all indicate that the proper measure of benefits for navigation improvements is the difference between the incremental costs of providing the service via the waterway and the incremental costs via the lowest cost alternative mode of transportation. Up until the present time few if any projects have been so analyzed. The principal reason for this is that some question exists regarding the quality and adequacy of the transportation cost data that are available. This applies particularly to rail transportation. The rail cost data that are available are the so-called territorial cost data published by the Interstate Commerce Commission. For this purpose the Commission divides the nation into four broad regions. The published data includes the average out-of-pocket costs and the average fully distributed costs for all rail carriers in each region, by mileage block, type of equipment, and tons per car. They thus represent broad aggregated data. However, it is possible to approximate the costs of a specific movement by adjusting the items in the ICC Rail Form A. Thus if the number of switches for a particular movement is known and is different from the territorial average the territorial costs for this item can be adjusted accordingly. Similarly with the other items of expense in Rail Form A. Such adjusted cost data are those usually introduced in proceedings before the ICC.

21. Time does not permit going into this very complex subject in any great detail. The Board staff has been studying the matter for some time. There is a rather wide divergence of opinion on the subject of the quality of the data. My own view is that while the cost data that are available are not sufficiently precise to permit an unqualified estimate of actual costs of specific movements they are sufficiently precise to be a very valuable aid in making a final judgment on a particular project. For example, where a project is only marginally justified on the basis of rates but on the basis of costs fails of justification by a substantial margin a negative recommendation would appear to be warranted. All current and future navigation reports where alternative modes of transportation are involved will have to give very careful consideration to this problem and, if rates are used, show their relation to costs.

22. Two developments, one short range and one long range, may assist us in the evaluation of such projects. The first is the recent emphasis on improved cost data. The Doyle Committee laid great stress on this. (5) A key recommendation of the Committee was for the development of improved techniques for obtaining cost data. In this connection the ICC has underway the computer programming of Rail Form A. This may make it possible to obtain a relation between the costs of particular carriers and the average territorial costs. The long term improvement referred to is a trend toward cost-based pricing in transportation. Noting that the Doyle Committee laid great stress on cost related rates

(5) "National Transportation Policy" - Report prepared for the Committee on Interstate and Foreign Commerce, U. S. Senate. Committee Print, 87th Congress, 1st Session.

Professor Nicholson of Clark University, who worked with the Doyle Committee, recently stated "* * * that policy which encourages cost-related prices is the most effective single method of insuring good transportation performance * * * * The economic importance of policies that insure that essential transportation needs of a country are met with a minimum expenditure of economic resources can hardly be exaggerated."

23. There is one final point that the seminar discussion has brought out with reference to navigation. Since we are discussing comprehensive planning as related to water resources development, we also need a broader focus on planning related, not to navigation per se, but to transportation generally. For example, in estimating the prospective traffic for a waterway we need first to know the total transportation service that will be required in relation to the future economy of the region as projected in the economic base study. Then we need a determination of the intermodal distribution of this total, taking into account the changing economics and participation of each mode. Only if we adopt this broader view can we contribute fully to the attainment of the goal of a fully efficient and coordinated transportation system with a minimum expenditure of resources. We must look increasingly to the Department of Commerce for guidance in this area and some of the research which Mr. Nupp (pages 130-134) indicated is getting under way will be of assistance.

24. Deep-draft harbors. I want to discuss briefly one other phase of navigation where both the problem of plan formulation and evaluation is involved, namely, in deep-draft harbors serving supertankers. In the past when the great majority of our ports were 35 feet or less in depth improvements generally served all classes of ships including general cargo vessels, dry bulk carriers and tankers. The trend to supership particularly for carrying crude petroleum and petroleum products has led in recent years to many requests for deepening harbors beyond 35 feet. Although in some instances dry bulk carriers are also involved in most cases such improvements are for the exclusive benefit of petroleum tankers. This introduces a new dimension in plan formulation since in these latter cases the liquid nature of the cargoes involved offers alternatives other than deepening that would not be feasible where general cargo and dry bulk commodities are also involved. Alternatives such as offshore loading and unloading facilities with pipeline connections to shore storage, and long piers carrying pipelines to deep water wharves, are not only feasible but have been constructed at many world ports. It therefore seems that in order to evaluate properly a harbor improvement solely for the benefit of supertankers we need to consider these alternatives. This introduces problems involving joint use of facilities, product integrity, and other complexities. The Corps is attempting to work out some of these problems with the industry. This will take time. But in the meantime we cannot ignore such alternatives and assume that the only answer to handling the modern supertanker is by continued widening and deepening of existing channels. Such solutions are becoming enormously costly in many locations. Even where such deepening can be justified by the transportation savings this is not a true measure of the worth of the project since one of the other alternatives may be superior.

Therefore full consideration must be given to all practical alternatives.

25. Water quality control. Water quality control presents one of the most difficult areas of evaluation. First of all many of the highly complex interrelationships that occur in a stream where pollutants are introduced are not well known. Also the everchanging condition of the stream makes it difficult to measure accurately many of the important parameters in physical let alone economic terms. A considerable amount of research is being done in this field both from the physical and biological aspects as well as on the economic considerations. The Resources for the Future and the U. S. Public Health Service have studies underway. Allen Kneese's "Water Pollution Economic Aspects and Research Needs" is an excellent introduction to the subject.

26. I think we all recognize the shortcomings of our present procedures. What we do, in effect, is to set certain standards of quality as a goal, design the system to supply the flows needed to meet the standards, and then determine the benefits based on the lowest cost alternative way of providing equivalent flows. One of the questions that arises in considering the inclusion of water quality control in a project is whether or not there is a real demand for this purpose. In the absence of the Federal project would local interests set the same standards and devise similar ways to meet them? As indicated earlier unless there is a real demand for water of a certain quality the method of estimating its worth by means of alternative costs is not valid.

27. Another difficulty in measuring water quality control benefits is that some of the important effects are intangible. Considerations of health, or the esthetic worth of a clean stream, are examples. However, many of the effects are tangible and measurable. For example, the provision of cooling water, the savings in use of soap and detergents by reducing the water hardness, the reduction of corrosion of fixed and floating plant, the reduction in municipal and industrial water treatment costs, and the reduction in damage to recreation and fish and wildlife resources can be measured at least approximately. Much progress could be made if we were to make a concentrated effort to circumscribe these measurable effects of water quality control. Recognizing that this is only part of the story we would at least narrow the area that depends on intangible considerations for its justification and reduce the area of doubt generated by our current procedures.

28. The seminar discussion of the problems connected with water quality control and the role of the U. S. Public Health Service in helping to solve these problems (pages 124-129) permit a measure of optimum. The solution of some of these problems is, of course, in the future, perhaps 5-7 years away, but the necessary study and research is underway. In the meantime we can anticipate an increasing body of knowledge that will permit the gradual refinement of our analyses and planning. A suggestion that we can in some cases design real alternatives to water quality control other than dilution by means of single purpose storage projects merits attention. For example,

the conveyance of wastes to points of dilution may be a feasible alternative to consider in some cases. Finally the caution is worth repeating that in making future estimates we cannot simply assume continuance of present patterns of use, but must consider carefully the more efficient water use made possible by technological advances (the by-product use of wastes in the sugar beet industry and the development of biodegradable detergents are good examples.)

29. Recreation. The emerging importance of recreation in water resources development was recognized by Congress in Section 4 of the Flood Control Act of 1944. The authorities provided therein gave the Corps considerable range in providing for recreation at reservoirs. In actual performance the role of the Federal Government was somewhat restricted under guidelines established by the Executive Branch and Congressional Committees. This was somewhat at variance with the tremendous growth of water-based recreational demand as indicated by the recreational visits to Corps projects. These increased 8 times between 1950 and 1962 reaching an alltime high of 127 million visits in the latter year. The principal effect of S.D. 97 is to increase the importance of recreation in water resources development. The former somewhat dubious role of recreation and fish and wildlife in water resources planning has been clarified. Recreation is to be considered on a more comparable basis with other uses of water. This increases the importance of the task of evaluating recreation and fish and wildlife benefits. Although recreation is, as indicated earlier, a marketable service it is usually provided without charge. Hence the market does not provide a basis for evaluation. Although referring specifically to sport fishing benefits Professor Crutchfield succinctly stated the reasons for the condition as applied to recreation generally (6) "It is worth repeating that this value is not inherently incapable of measurement. In a few cases, unfortunately of trifling importance, lake and stream fisheries (or the temporary right to use them) are sold on a purely business basis. The essential problem is not that the service is intangible but that law and tradition make it accessible on a basis which does not measure our willingness to give up other things to enjoy our sport. It is necessary to simulate the results of a market pricing mechanism which is not permitted to operate because it is inconsistent with a policy of complete equality of access to outdoor recreational resources." Because the evaluation is not performed by the market mechanism we are forced to approximate the value of recreation by other means. Evaluation of recreation benefits has generally fallen into one of three methods - expenditures, income, and imputed value per user day. All three methods have serious shortcomings. The last one, currently in use by the Federal agencies, is perhaps the least objectionable. Values currently used are based on a schedule provided by the Inter-Agency Committee on Water Resources. To the extent that

(6) Land Economics, May 1962

these values simulate the market mechanism as Professor Crutchfield suggests and are representative of what people would be willing to pay for the recreation they are appropriate measures of value. However, the schedule provides a wide range from among which specific unit values must be selected on a judgment basis. It is understood that this matter is under further study by the Interagency Panel and a further report is expected in the near future. An item of equal importance is development of projections of demand for forecasting recreation needs. Much work along this line has been done by The Outdoor Recreation Resources Review Commission (ORRRC). Study Report No. 23, in particular, should prove to be a valuable aid for this purpose. The presentation by Mr. Caulfield (pages 107-114) indicates that the newly created Bureau of Outdoor Recreation will also provide valuable assistance in this area.

30. Senate Document 97 has something of significance to say on several other items of cost and benefit evaluation which time does not permit me to discuss. I strongly urge a careful reading of that document by all concerned. I am sure such a reading will generate much fruitful thought on the subject of costs and benefits.

31. It is rather obvious from this brief review of the costing and evaluating of water resources projects that we have not progressed to the point where the art of measurement of the costs and effects permits a truly objective and precise assessment of a proposed project. However, much progress is being made and the amount of research underway in this area indicates that the tools for such measurement are being honed ever more sharply. Although judgment will always enter into the final decision we must continue to improve the basis for such judgment by defining the data and information on which it rests as precisely as we know how.

CONTROL OF FLOOD PLAIN USE

by
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Office of the Chief of Engineers

OBJECTIVE

The objective of controlling the use of the flood plains as well a controlling floods is to reduce the human suffering which occurs when floods cause loss of life, impairment of health, inconvenience and property damage. In our expanding economy, elimination of all flood damages by means of physical measures seems to be beyond practical accomplishment. Present expenditures of over $500 million annually for flood protective works must be augmented to keep up with the increase in potential flood damages to new developments in the flood plains.

Control of flood plain use does not mean allowing the land to lie idle, even for areas not protected by physical flood control measures, but does mean proper use taking into account the flood hazard and the need for or advantages which flood plains have.

CONSIDERATIONS

The Corps of Engineers has an interest in control of flood plain use from two aspects. One, to prevent developments which would reduce the effectiveness of the physical flood control measures which it build and the other, to reduce flood damages in areas where dams, levees or channels, are not justified. And, as well, reduce damages in flood plains where projects are justified but are awaiting authorization, appropriation of funds and construction. Many millions of dollars of damages are suffered every year in such areas but because of budgetary and capability limitations the projects are not yet in being.

Maintaining project effectiveness. Dams and reservoirs are partic ularly subject to a reduction in effectiveness by developments in downstream flood plains which prevent optimum release of stored water. Mar people, when they see a dam upstream from them assume that there will b no more floods and proceed to put developments - structures or crops - along the banks. Presumably, we have the legal authority to operate th dam in accordance with the established rule curve, but when such releas will cause significant damages, the dam operator is reluctant unless he is sure that the reservoir will spill.

Encroachments on improved channels, in addition to being subject t flood damages, may be obstructions to flow and cause increased flood heights and greater flood damages.

Reducing flood damages where physical measures are not justified. Since the Corps of Engineers has been in the flood damage reduction business nationwide for almost 30 years, who would be a better group to advocate ways of reducing flood damages in areas not protected by dams, levees and channel improvements? Lower-cost site development and sometimes the esthetic values of flood plain locations tempt people to choose to build in the flood plain. Sometimes it is with knowledge of the chances they take but often without that knowledge. We have a great opportunity to reduce flood damages at little expense to the taxpayers by informing the people of the hazard of developing in the flood plain and encouraging them to plan and control its use.

DETERMINING PROPER USE

Proper use of flood plain lands depends on such factors as:

The amount of land available outside the flood plain to meet present and prospective needs and the costs of development at such sites.

The advantages of flood plain land from an economic viewpoint which include low-cost site development if the cost of flood protection or suffering flood damages are neglected; and accessibility to water, transportation facilities, and utilities.

The advantages of flood plain land from a social viewpoint, which include the esthetic value of being near water.

The disadvantages of flood plain sites from an economic viewpoint, which include the cost of flood protective works including flood proofing, and/or suffering flood damages and the threat to lives and health of people.

The suitability of flood plain land for certain uses which are not subject to much damage, e.g., open spaces, ball parks, and parking areas.

Optimum use of flood plain land can only be determined by comparing alternatives which take into account the advantages and disadvantages. Establishing the value of the advantages and the cost of the disadvantages is difficult even for those which can be measured in monetary terms. This should not, however, be an excuse for not trying.

One way to go about comparing the alternatives is to prepare an optimum economic land use plan, proceeding with the following steps:

1. Estimate land needs
2. Survey potential sites
3. Estimate the cost of most economical means of developing outside the flood plain.

4. Estimate the cost of the most economical alternative for using flood plain land.

5. Make an optimum economic array of sites. A more complete discussion of this procedure, although it is yet unperfected, is contained in a paper presented by Sutton[1] at the ASCE Environmental Engineering Conference in Atlanta in February 1963.

Decisions on the best land use plan cannot, however, be based on social or economic factors alone. They both may be taken into account by devising a plan, as described above, which optimizes monetary values and then modifying it if judgment indicates that the social values would be worth the additional cost.

METHODS OF CONTROL

There are several ways of effecting control of the flood plain once a plan has been developed. Some are based on the exercise of police power; others on controls exercised by institutions who control the purse strings.

The authority to establish regulations, which include encroachment line statutes, zoning ordinances, subdivision regulations and building codes, is vested in the States. This authority has frequently been passed on to local governments, but in some States is still retained by State governments. Lending institutions, such as banks and the Federal Housing Administration exercise control of development by withholding loan approvals or attaching restrictions to loans. Further, the land can be controlled by purchase of easements or fee titles. The non-availability of flood insurance, to some extent influences the use of the flood plain. In addition, governments eligible to assess taxes could set discriminatory rates on developments in the flood plain, on the basis that public services to such properties are more expensive than to others.

Primary dependence for preservation of flood control project effectiveness will be on establishment of encroachment lines. They apply to stream reaches downstream from dams, along floodways and improved channels and are defined as lateral limits or lines along streams or other bodies of water, beyond which in the direction of the stream or other body of water no structure or fill may be added. They are also used to establish designated floodways so that a selected flood will pass without a significant increase in flood heights or significant flood damages to new structures.

Zoning ordinances include the establishment of encroachment lines, but usually extend beyond the limits of the floodway and divide the flood plain into zones reflecting different degrees of control and suitability for different kinds of uses, usually related to the degree of risk.

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(1) Sutton, Walter G., "Planning for Optimum Economic Use of Flood Plains"

Subdivision regulations may accomplish the same purpose as zoning ordinances by applying requirements as to uses and structural designs.

Building codes likewise may include standards for construction whi will reduce or eliminate flood damages.

Flood plain regulations can include requirements for flood proofir measures which would reduce flood damages. Flood proofing is defined a a combination of structural changes and adjustments to properties subje to flooding primarily for the reduction or elimination of flood damages Sheaffer (2) listed 21 measures that come under this heading in his boc on flood proofing. The most common means are raising elevations of roa beds and buildings and closing openings.

RETROSPECT

Writings. The earliest written statement on flood plain use adjus ment which I have been able to find is included in an article by Gilber White (3) written in 1936, where he stated "Land planning has additiona importance as it relates to the feasibility of reducing flood wastage b means other than protection. It seems entirely possible that in some flood plains change in location and structure of buildings or modificat of farming system may yield net gains greater than those from control o preventive works."

Other writings appeared in the years immediately following including the editorial in Engineering News Record, March 1937; "The River Has Rights", and "Flood Control and the Cities: Land-use Policies Which May Aid in the Development of Flooded Areas in Some Communities," American City, March 1937.

(2) Sheaffer, John R., "Flood Proofing: An Element in a Flood Damage Reduction Program," University of Chicago Department of Geography Research Paper No. 65, Chicago, 1960.

(3) White, Gilbert F., "The Limit of Economic Justification for Flood Protection," The Journal of Land and Public Utility Economics, Vol. XII, No. 2 (May 1936), pp. 133-148.

In 1942, Wertheimer[4] wrote a rather comprehensive paper in which he pointed out that "increased flood damages are due to increased intrusion on the flood plains of rivers," and advocated control of the flood plain to ameliorate this condition. It is interesting to note that he considered one of the obstacles to such a cure, to be the lack of information on which to base controls.

About 1950 quantity writing on the subject was resumed, culminating in the last five years in six books and dozens of articles, some large and some small, Gilbert White still being an important contributor. James Goddard, of Tennessee Valley Authority, by his own papers and distribution of literature in this field has stimulated interest in writing on this subject.

Congress. The U. S. Congress has demonstrated its interest in control of flood plains by authorizing Corps of Engineers projects containing items of local cooperation necessary to protect project effectiveness. In 1961 Hertzler[5] reported that Congress had authorized Corps of Engineers projects containing the following restrictions:

Prevention of channel encroachment	88
Prevent encroachment of ponding areas	12
Partial evacuation	2
Building restrictions	12
Prevent floodway encroachment	9

The Congress, however, has consistently refused to require regulation of flood plains where such would not bear on the effectiveness of a Federal project. For example, the Senate Committee on Public Works[6] in 1960 did not concur in a recommendation for a requirement of local zoning of areas not within the reach of the channel improvement project. (See Attachment A, page 359, for full quotation).

The Congress, on the other hand, in 1960 reflected its concern "over the increasing use and development of the flood plains of the rivers of the Nation, which presents additional areas, developments, and improvements, that are subject to flood hazards, with increased flood losses and damages."[7] Because of the belief that if people knew the hazard of developing in the flood plain they would do better planning and that "The Corps of Engineers has

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(4) Wertheimer, Ralph B., "Flood Plain Zoning," California State Planning Board, June 1942.

(5) Hertzler, R. A., "Corps of Engineers' Experience Relating to Flood-Plain Regulation," Papers on Flood Problems, University of Chicago Department of Geography Research Paper No. 70, Chicago, 1961

(6) Senate Committee on Public Works, 86th Congress, 2d Session, Report No. 1524, "River and Harbor, Beach Erosion Control, and Flood Control Projects," June 6, 1960, pp 140, 141

(7) Ibid, p 114

assembled much flood plain information during the conduct of its authorized responsibilities for flood control, and has the personnel and organization qualified tc undertake a parogram of this kind," (8) it included in PL 86-645 authority for the Corps' flood plain information studies.

Corps of Engineers. One of the early proposals by the Corps of Engineers for control of the flood plain was contained in the River and Harbor Board's recommendations on the 1940 Missouri River, Sioux City to Kansas City report, as follows: "that the States having a common boundary on the Missouri River shall, as a condition of construction along the portion of the river, establish by interstate compact floodway boundary lines and floodway regulations satisfactory to the Secretary of War. However, this recommendation was eliminated.

The Corps of Engineers has had for many years a requirement in its instructions that favorable reports will recommend suitable remedial measures and local cooperation to preserve channel capacity and effectiveness of project operation (para 77f, EM 1120-2-101, see Attachment B, page 360 for full quotation). The record of the Corps of Engineers' accomplishments is reflected in the tabulation of restrictions included above. A significant example is quoted from Hertzler's paper (9) as follows:

> 'The local flood protection for Princeton, West Virginia, requires the city of Princeton and Mercer County to take necessary action to prevent future construction of residential buildings with first-floor levels below elevation 2399 feet mean sea level on about 421 acres, of certain low-lying lands within, and adjacent to, the corporate limits. This restriction was imposed in order to assure that construction of the project would not increase the possibility of loss of life in the event of the occurrence of a flood approaching the magnitude of the Standard Project Flood (crest elevation 2399) which greatly exceeds the design capacity of the improved channel."

A recent example of a requirement for control of the flood plain to preserve project effectiveness is included in the 1960 survey report on Rondout Creek and Wallkill River, New York and New Jersey. Item d of the District Engineer's proposal for local cooperation reads as follows:

> 'Protect the channels, ponding areas, and other flood works from future encroachment or obstruction, including waste disposal, that would reduce their flood carrying capacity. Also agree to take appropriate measures to control development of the fringe areas not

8 Ibid, p 192
9 Op.cit., p 192

fully protected by the considered improvement, as discussed under section XXIV, Flood Plain Zoning, with a view to preventing undue increase in the flood damage potential."

The Section XXIV referred to includes general guidance on flood plain zoning and specific requirements for flood plain control where projects are recommended. In addition it contains specific suggestions for flood plain control at towns where projects were not found feasible. Appendix K of the report, "Flood Plain Zoning", expands on Section XXIV and provides most of the flood plain information needed by the State or local governmental agency to adopt the necessary regulations.

The hurricane survey report for the Eastern Shore of Virginia (10) is a good example of an unfavorable report which provides flood plain information. It contains data which the State and local governmental agencies can use in establishing flood plain controls as well as suggested actions to reduce future flood damages.

The comprehensive plan for the Delaware River Basin (1961) considered control of the use of flood plains as an important adjunct to the physical remedial measures recommended. The report lists the local flood damage centers and the approximate number of acres inundated by large floods, which would not be protected by the recommended projects. It contains some of the information needed to plan and control the use of the flood plains and points out that the Corps of Engineers could under P. L. 86-645 provide additional data, if requested.

The flood plain information studies program of the Corps of Engineers got underway when the first appropriations became available in 1961. The following tabulation shows the status of the program on 10 May 1963.

Applications approved	65
States involved	28
Studies covered by approved applications	137
Studies completed*	2
Studies, final draft being reviewed in OCE	10
Studies underway in field offices	69
Studies approved and scheduled for initiation in FY 64	25
Studies approved but scheduled after FY 64	31
Studies for which applications are in process	40

* Farmington, Michigan, and American River, California

(10) H. Doc. No. 599, 87th Cong., 2d Session

Total estimated cost of approved studies	$2,750,000
Estimated cost of studies for which applications are in process	$ 700,000
Appropriation FY 62	$ 500,000
Appropriation, FY 63	$ 700,000
Budget request, FY 64	$ 715,000

Other Federal Agencies. The Tennessee Valley Authority has been preparing flood plain information studies since 1952 within its geographical area and has delivered "flood hazard reports," to about 100 local communities. Some 30 of the communities have adopted flood plain regulations.

The U. S. Geological Survey has completed 17 flood maps in its Hydrologic Investigation Atlas series and 10 more are nearing completion. The earliest map was for Topeka, Kansas, completed in 1959.

Federal lending agencies, primarily the Federal Housing Administration has for several years consulted the Corps of Engineers and the U. S. Geological Survey for flood hazard information when proposed structures might be located in the flood plain.

Urban Renewal Administration requires that its project proposals take into consideration the cost of providing flood protection. It also suggests, for its open-space land program, that flooded stream valleys can become assets for recreation facilities.

Community Facilities Administration requires, when a proposed facility would be located on a flood plain, that the Corps of Engineers be consulted for information as to the degree of hazard involved. If the problem is serious, CFA will advise the applicant that the Corps of Engineers has authority, under Public Law 86-645, Section 206, to make flood plain information studies.

States. Authority to regulate land use, including the flood plains, resides in the States. The Federal Government does not have this authority except on Federally-owned land. Cities and counties do not have such authority unless it is granted to them by the State. Therefore, the States hold the key to responsible action for regulating flood plain development."(11) Eleven States have enacted encroachment or floodway statutes but all the States have either passed general or specific legislation enabling local governments to zone flood plain land.

) Morse, Henry F., Role of the States in Guiding Land Use in Flood Plains, Georgia Institute of Technology, June 1962

Tennessee is one of the States which is active in encouraging and assisting local communities in doing something about their flood problems. In 1960 the Tennessee Planning Commission prepared a report on a survey of the State's flood situation, trends in vulnerability, and a proposed program for action. The report suggests land use planning and flood plain controls as means of reducing flood damages.

PROSPECT

We in the Corps of Engineers should look for all opportunities to advance the movement toward planning for optimum use of flood plain lands, and when required, the exercise of proper controls to effect the results of such planning. Examples of prospective actions follow:

Flood Plain Information Studies

a. Expedite the accomplishment of flood plain information studies within the limitations of funds and available man power.

b. Prepare flood plain information reports which contain the technical data that city planners and engineers need to accomplish the desired planning.

c. Write summary reports which will convince the public that there is a flood hazard related to flood plain development, and that reasonable proposals for legal controls which States or local governments propose should be supported.

d. Write the reports which are to be distributed to the public in a length and style which will result in their being read and understood.

e. Provide technical advice and assistance to States and local governmental agencies on proper use of flood plain lands.

Survey Reports

f. Base survey report studies on land use plans which satisfy the requirement that alternative uses of flood plain lands and alternatives to using the flood plain land have been examined.

g. Recommend in survey reports items of local cooperation for adequate flood plain controls to protect project effectiveness. The reports should provide an approximate location of encroachment lines and zone boundaries. The final locations should be provided in the detailed planning stage.

h. Include in favorable survey reports information on the extent of the flood plain and the hazard of development without the project so that persons can judge the advisability of staying out until the project

is completed. Reports should also provide information as to residual flooding after project completion.

i. Prepare unfavorable survey reports so that they will serve as flood plain information reports. Although we do not have authority to make widespread distribution of survey reports they should be made available to agencies who would use them in land use planning. Press notices announcing release of the reports should incite interest in alternative measures for reducing future flood damages.

Comprehensive River Basin Planning

j. Recognize in comprehensive river basin planning all flood damage reduction alternatives.

k. Whenever practicable, include flood plain controls as elements in comprehensive river basin plans.

l. Include in comprehensive river basin reports the locations where flood plain controls should be considered and guidelines for planning and/or controlling the use of the flood plain.

Education

m. Make every effort to spread the word that the occupance of flood plains is hazardous; that people should find out where the flood plains are and that they will likely save themselves much suffering if they stay out or make adjustments, such as flood proofing. Opportunities include public gatherings, schools, community improvements organizations and fairs where exhibits may be presented.

n. Encourage and assist in the organization of local committees to consider all possible means of preventing or abating flood damage, including land use controls.

o. Encourage States to actively assist local governments in planning and/or controlling flood plain lands and to provide appropriate enabling legislation.

2 Incls:
Attachment A, page 359
Attachment B, page 360

Extract from Report No. 1524, Senate Committee on Public Works, on River and Harbor, Beach Erosion Control, and Flood Control projects, June 6, 1960, 86th Congress, 2d Session

FORT WORTH FLOODWAY, TEXAS

"Remarks. - The committee has given careful consideration to the recommendations of the Chief of Engineers and to the views of the State and Federal agencies regarding the extension of this project. The Bureau of the Budget has indicated that favorable consideration of any request for funds to initiate construction of the project would be contingent upon local interests establishing flood plain zoning of a large area of relatively undeveloped land within the flood plain and lying outside of the area afforded protection by the recommended improvements. The committee notes that the Chief of Engineers has suggested in his report that local interests give consideration to zoning the flood plain in the area not to be protected by the proposed improvements. The committee is in accord with this objective. However, while the committee considers it desirable for local interests to accomplish flood plain planning, including zoning where justified, it feels that a requirement for such zoning is not appropriate since this is a local function. Also, the committee notes that in the subject case the area for which zoning is proposed lies outside the area to be protected. An item authorizing this project in accordance with the recommendations of the Chief of Engineers has been included in the omnibus bill. In this connection, the committee recommends that when the Congress considers appropriating funds for construction of this project, that failure on the part of local interests to zone the flood plain in the unprotected area, not be held as a bar to the appropriation of such funds."

Extracts from EM 1120-2-101, "Survey Investigations and Reports, General Procedures," Department of the Army, Corps of Engineers, Office of the Chief of Engineers

1-77f.

"Preservation of channel capacity. The flood channel capacity needed and provided in connection with flood control works of all kinds must be preserved in order that the works will be effective and the potential benefits realized. Reports will discuss the problem of encroachments on flood channels and floodways and developments of flood plains. Favorable reports will recommend suitable remedial measures and local cooperation to preserve planned channel capacity and effectiveness of project operation. Some possible measures, other than engineering works, include fee acquisition of lands, flowage easements, regulations controlling channel encroachments and obstructions, and regulation of flood plain development (See also par. 1-84q)."

1-84q.

"Flood plain regulation. Flood plain regulation, including zoning and various other regulatory measures, are generally local responsibilities involving the exercise of the police power of the State. However, when some form of local regulatory action is required to safeguard channel and floodway capacity to prevent encroachment and to insure the effectiveness of proposed Federal projects, reports will recommend that local interests adopt and give assurances that will enforce appropriate regulatory measures relevant to project requirements."

ATTACHMENT B

RESERVATION OF RESERVOIR SITES

by
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Office of the Chief of Engineers, Washington 25, D. C.

I. The Problem

1. Perhaps the most controversial feature of any program for development of the nation's water resources has been the requirement to acquire vast quantities of lands for storage reservoirs in competition with past and prospective land uses in both the private and public sectors of the economy. This feature was not too critical during the earlier years of the Federal program, generally prior to World War II, when the need for almost total development of the resource was not clearly established. At that time there were sufficient storage sites available to meet prospective needs in relatively undeveloped areas of the country and such sites could be acquired at reasonable cost and without seriously competing with other more intensive uses. The lands required were almost entirely rural in character and improvements were limited generally to the existance of farm buildings and relatively minor rural communities. The existance of highways and railroads which had been constructed in the river valleys in some cases added materially to the costs of developing sites but did not seriously jeopardize their economic justification.

2. Since World War II the problem of obtaining suitable reservoir sites has become progressively more acute. Paradoxically, the rapid growth in population, urbanization and industrialization that has been experienced is causing developments to take place on lands in our river valleys in competition to the requirements for the storage reservoirs which are necessary to serve their needs and to permit continued economic expansion. One can reasonably conclude that the essential public services afforded by reservoirs will ultimately take precedence and that, when necessary, other improvements which impede development of reservoirs will ultimately be moved when demands for services are critical enough to warrant such action. However, this would be a most wasteful and short-sighted practice and obviously should be avoided if at all possible. More logically our planning for water resources development must be sequenced in such manner as to clearly establish the requirements for specific reservoir sites far enough in advance of other economic development which would likely take place to assure that officials who have the opportunity to make decisions governing land usage have full knowledge of the facts so that they may properly weigh alternative courses of action. A public disclosure of the facts is in itself no measure of positive control but it does help gain public understanding of the problem and in many instances will point the way to the more specific actions that will be necessary to accomplish the objective of preserving reservoir sites.

II. Background

3. Considerable attention has been given to this problem in recent years particularly with respect to the increases in costs of lands and relocations that have been experienced on authorized projects during the time of authorization and construction.

a. The 1951 investigation by the House Appropriations Committee showed that the costs of lands and relocations for 182 Corps of Engineers projects of all types then underway had increased 123 and 177 percent respectively and accounted for a substantial portion of the total increase experienced on reservoir projects between time of authorization and 1950. The increases experienced were attributable largely to developments that had taken place in project areas since authorization and to the inflation of land values in anticipation of changes in land usage.

b. The House Appropriations Committee report on the FY 1957 Appropriations Bill pointed to public improvements that had been taking place in project areas subsequent to project authorization necessitating relocations at project expense which in some instances were so costly that previously justified projects become unjustified. The Committee emphasized the need for better coordination of public programs. While the Committee's remarks were directed toward coordination of work with that of other public agencies, it was also apparent that private developments in project areas represented an equally or more serious aspect to the problem.

c. As an initial step for accomplishing coordination, a multiple letter was issued to field offices in 1956 (subsequently replaced by EM 1165-2-108) directing Division and District Engineers to institute a program for informing other Federal, State and local agencies and the public generally of the scope and effects of authorized civil works projects and soliciting their cooperation in the planning of improvements within project areas. It was recognized that a voluntary program of this nature would have only a minor effect on curbing developments in project areas, but it served to obtain a better public awareness of the problems and encouraged an exchange of information between public agencies which has been helpful in resolving specific conflicts, particularly with respect to highway improvements. These instructions also provided that more recognition be given to this problem and specific solutions in survey reports so that it might be given consideration by the Bureau of the Budget and the Congress in connection with project authorizations.

d. In his Natural Resources Message of 23 February 1961, President Kennedy recommended measures designed to strengthen comprehensive river basin planning, and indicated that a major reason for such planning is to provide a basis for identifying the need and location of future reservoir sites far in advance of construction.

e. In furtherance of the President's objective, the Department of the Army in consultation with the Bureau of the Budget and the Department of

Interior prepared draft legislation to provide for the preservation of reservoir areas and other sites needed for future development for navigation, flood control, water supply, irrigation and other purposes. The draft bill was primarily a statement of policy setting forth the actions that might be taken both with respect to authorized projects and to the preparation of plans leading to authorization of projects but would have provided no new authority for accomplishing the measures that might be recommended. It was concluded that the agencies could already make such recommendations within existing procedure, and the Bureau of the Budget deferred action on transmitting the draft bill to Congress. Subsequently, by letter of 22 August 1961, the Director of the Bureau of the Budget requested that the Departments of Army and Interior undertake cooperative studies of the problem of encroachment of developments on major reservoir sites, and to determine the need for appropriate actions required to preserve sites, including legislation if necessary. The following guidelines were established:

(1) Emphasis should be placed on measures required to preserve important sites threatened by imminent encroachments.

(2) The measures proposed should represent the minimum necessary action consistent with the objective of site preservation, and

(3) Reliance should be placed where feasible on State zoning and other measures to keep lands on local tax rolls until sites are needed for development.

Some preliminary discussions have been held with Interior officials but no course of action has yet been adopted.

III. Positive Actions Taken

4. Authorized Projects. While the information program instituted in 1956 has been helpful in establishing coordination with public agencies and in pointing up specific problems, there have been relatively few instances where adjustments have been made in the program of another public agency. The primary problem is one of defining a projects requirements where advance engineering and design has not been accomplished so as to permit planning and construction of other improvements such as highways to proceed in an orderly fashion and without added costs being assessed against the sponsoring agency. The Bureau of Public Roads in particular has been very helpful in trying to resolve conflicts that exist between the Corps' program and the Federally supported highway program but the only cases on which this has been possible have been where the Corps has been able to make arrangements to pay the added cost involved prior to the availability of funds to initiate project construction. Through an item in the FY 1962 Appropriations Act we have arranged to participate in the cost of modifying an important highway to accommodate the authorized Kaysinger Bluff Reservoir even though appropriations have not yet been made to initiate project construction. In this instance it was indicated that a savings of about $1.8 million would result if the road were modified initially as opposed to later adjustment when the reservoir is constructed.

5. We may reasonably expect that the Bureau of the Budget and the Congress would look favorably on similar proposals where the justification for advance participation can be established and there is reasonable prospect that the project will be built. It is important that we have full information in such situations sufficiently in advance to permit funding in our annual budget without unduly delaying the work of other agencies.

6. Projects considered in survey reports. As indicated earlier in reference to the President's message on natural resources, a major purpose of the measures recommended by the President developing comprehensive river basin plans is to identify the need and location of future reservoir sites far in advance of construction. Logically we must recommend the steps that should be taken to protect those sites from encroachment if availability when needed is to be assured. Careful study of this problem, particularly in highly developed areas of the country, is an important phase of the planning process and should be dealt with directly in the reports on such investigations. Our report on the Delaware has established a noteworthy precedent for doing this. That report took cognizance of the fact that the eight major reservoir sites which were recommended for authorization as part of the main control plan for development over the next 50 years may not be available unless steps are taken to preserve those sites in essentially their present condition of land use. In consideration of this problem the District Engineer concluded that the most practicable means of preserving reservoir sites would require:

a. That the dam sites be firmly fixed by detailed site investigations immediately following project authorization.

b. Land acquisition programs, based on detailed dam site surveys and project land needs, be initiated as soon as practical and pursued in an orderly manner until the preservation of the reservoir site is assured.

c. Leaseback or other types of programs designed to keep the acquired lands in productive use until they are needed for reservoir purposes.

d. Programs to mitigate the effects of the land acquisition program on the taxing structure and incomes of such governmental units as school districts, townships and counties.

Accordingly the District Engineer recommended, and the Chief of Engineers concurred, that immediately following authorization, detailed site investigations and designs be made for the purpose of accurately defining the project lands required, and that subsequently advance acquisition be made of such title to such lands as may be required to preserve the sites against incompatible development. The Congress authorized the plan in accordance with the recommendations of the Chief of Engineers.

IV. Discussion

7. The problem of encroachment on reservoir sites is national in scope, but may be considered to be of serious consequence only where sites are located near population centers or in river valleys which are used as

important transportation arteries. Our ability to cope with the problem, or at least to recommend a positive course of action for consideration by Congress, depends largely on our ability to define what sites are needed, their design and real estate requirements, and, of course, their essentiality in meeting short and long range water development needs. Thus, there is little opportunity to discourage development in an area of a potential reservoir until a survey report has been completed and a project plan is authorized by Congress, and detailed project planning has been accomplished to the point of defining the project's requirements.

8. With respect to presently authorized projects we must intensify our efforts to inform Federal, State and local officials concerned with other programs of the project needs and encourage their cooperation in giving us information as much in advance as possible on any future plans for improvements that might affect project areas. Unless detailed project planning is already underway, our ability to program and proceed with advance planning to establish project requirements would depend largely on the lead time that might be available. It is only at this stage that there is any reasonable possibility of securing voluntary cooperation, or if this is not possible, that we have a basis for recommending possible courses of action to the Congress. Such recommendations may involve a request for appropriations for advance land acquisition or where public improvements are involved, such as highways, to participate to the extent of paying any added costs which might be attributable to the water resource project.

9. As indicated earlier in this paper, one of the major objectives of the President's program for completion of comprehensive river basin plans is to identify reservoir sites and to assure their availability when needed. Such determination of needs should include an appraisal of the prospects for ultimate acquisition of the sites at reasonable costs and recommendations as to measures that should be taken to assure their availability when needed. The economic base studies which are an important phase of the comprehensive planning process should permit an assessment of the development that will likely take place in the basin, the areas in which such development is most imminent, and the probable timing. In areas of intensive development, such as the Delaware Basin, it became obvious early in the study that reservoir sites which would not be needed for as long as 50 years would not likely be feasible for development when the storage is needed unless they are retained in essentially their present condition of usage. Early accomplishment of detailed site investigations and designs, as recommended in the report should provide a reasonable basis for recommending action to reserve the sites.

10. Possible methods of controlling development on land needed for a future project, and their advantages and disadvantages are discussed below.

a. Federal Fee Acquisition with Leaseback:

(1) Advantages:

(a) Positive control over future development
(b) Avoids appreciation in land prices

(2) Disadvantages:

(a) Requires substantial investment, often long before benefits can be realized from the project.

(b) Takes property off State and local tax rolls with no compensating benefits unless special provision is made for off-setting payments.

(c) Introduces an element of risk that the project may not be required because of subsequent adjustments in the plan. However, considering experienced trends on land values, the land could be sold back to previous owners or on the market without any material loss to the Government.

b. Federal Acquisition of Easement Initially.

(1) Advantages

(a) Normally will require a lesser initial Federal investment but in some instances easements which are sufficiently restrictive to retain an area in its present state of usage would be almost as costly as direct purchase.

(b) Retains property on local tax rolls

(c) Less disruptive if it is later determined that project is not required because of changes in plans.

(2) Disadvantages

(a) Total Federal cost of land (easements plus ultimate fee acquisition) would ultimately be greater than initial direct purchase, however, this added cost would be offset, at least in part, by avoiding interest costs on the large investment required for initial fee acquisition.

(b) Future appreciation would make the land more costly when direct purchase is ultimately made.

c. State or local purchase or control of lands with Federal financial assistance.

(1) Advantages

(a) Would keep lands under local governmental control

(b) Federal financing could assure that lands would be available when needed for project purposes in such manner that it would not increase the cost of acquisition by the Federal Government.

(c) Returns from leasing lands prior to use for project purposes would help defray cost of Federal ownership.

(d) Lands could be put to interim use for park or recreational purposes thereby providing public benefits.

(2) Disadvantages

(a) Would have same disadvantages as Federal fee acquisition.

(b) Requires degree of action at State and local levels there heretofore has seldom been possible.

(c) No positive assurance that lands placed under control of State or local agencies and put to interim use would be converted to project use when needed. Despite agreements that might be obtained when Federal funds are made available, local resistance could bring about political pressures which would jeopardize ultimate project development.

d. Zoning by State or local Governmental Agencies

(1) Advantages

(a) Would follow established practice of controlling development in the public interest.

(b) Would not require any investment of Federal funds until project is needed.

(2) Disadvantages

(a) Local zoning authorities would have only a limited interest in projects which would provide benefits outside their jurisdiction.

(b) Local groups are seldom concerned with the cost of project development when the Federal Government ultimately foots the bill.

(c) Officials would seldom be able to withstand concerted efforts of pressure groups for changed land uses.

(d) Inequitable to property owners concerned.

V. Conclusion

11. The foregoing discussion of possible measures for protecting reservoi sites from private development would seem to lead to the conclusion that the most positive control, and the one most likely to succeed is for the Federal Government to acquire ownership through advance appropriations with appropriat consideration being given to permit interim use by former owners or by local governments for park or recreational purposes, and to compensating local jurisdictions for loss of taxes resulting from Federal acquisition. Where public improvements such as highways, utilities, or similar facilities may be contemplated there is ample precedent to recommend advance Federal participati in the cost to the extent occasioned by the proposed water resource project. In either case it is essential that the problem of reserving reservoir sites be clearly identified during the course of our studies and that full facts be presented in support of any course of action that may be recommended.

SCREENING OF ALTERNATIVES

(Methods of Progressive Refinement and Narrowing of the Field of Choice)

by

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INTRODUCTION

The basic objective of this seminar is to develop a practical means for formulation of the most efficient plan for development of the water resources of a basin. The purpose of this paper is to discuss various procedures that have been utilized to screen out alternatives and to reduce the work and cost of preparing a basin plan to practical limits. Prior topics have covered objectives, needs, design and economic evaluations of single projects, and the subsequent topic will cover the final selection of the optimum plan. Screening is the first stage that brings together all the topics previously discussed and uses them to set the stage for final decision. The degree to which screening of alternatives is used is a direct function of the complexity of the basin and an indirect function of the funds available for planning. The more planning funds are available, the less screening is necessary and the greater is the number of major alternatives that can be developed in detail during the final stage of the planning process. The greater the complexity of the basin, the greater is the number of possible solutions which must be screened to reduce the alternatives to those few that can be developed in detail. This paper will cover the steps that provide this bridge between single project analysis and selection of an optimum plan.

To work towards this goal the procedures used should consider three specific elements. These are: (1) the return on the investment made, (2) the utilization of the natural resources of the area, and (3) the distribution of the beneficial and adverse effects from the development both in time and geographical area.

The first element is measured by the amount by which the beneficial effects on the national and regional economy, measured in monetary terms, exceed the cost.

The second element is measured by the degree to which available natural resources are utilized without their waste.

The third element is measured by the degree to which a plan distributes evenly to each person the economic as well as the intangible benefits and costs.

This assumes that all benefits and costs can be evaluated, if not in monetary terms, then by sound judgment.

THE PROBLEM

In order to attain comprehensive development of the water resource of a river basin we may have to consider a large number of projects to serve varying needs, a problem that may be further complicated by physical conflicts between the projects and conflicts between the objec tives or needs. The number of potential combinations for study reaches astronomical figures. A publication by the Harvard Water Resources Program indicated that even in the case of a much smaller basin than th type we are considering today (eight units and only three major purpose to be served) the number of possible combinations to be studied might reach 10 billion. For a larger, more complex basin like the Delaware with more purposes to be served and as many as 193 dam sites (exclusive of small upstream detention structures) the possible number of theoreti combinations would be even greater.

It is obvious that we cannot study all possible combinations. Eve if we could partially solve the problems of time and manpower by giving the problem to machine computers it would be impossible to obtain all the basic data that would be required for analysis. We then have the problem: How are we to screen these projects and combinations and determine which should be studied in detail?

THE IDEAL SOLUTION

In recent years the field of water resource planning has drawn the attention of the economists and particularly those endowed with the ability to handle the intricasies of econometrics. They have been dis-satisfied with the economic analysis made by governmental agencies for what to them appears to be a lack of comprehensiveness and failure to give adequate recognition to all economic principles. They have develc numerous complex formulas for computation of such items as maximization national welfare, maximizing efficiency in the presence of a budget restraint, income redistribution, opportunity costs, long run productic function, social rate of interest, etc., and they have suggested method for incorporating these factors in agency evaluation procedures. In sc doing they have devoted considerable thinking to the overall problem ar have made numerous contributions to the literature. One of the most ambitious is the recent text "Design of Water Resource Systems" that resulted from the Harvard research program in which a number of those present have participated.

The economists are fully aware of the complexities in analysis introduced by the many variables that must be considered. In an effort to handle the many computations involved they have turned their attenti to the use of high-speed digital computers. One approach, and the problems involved, are described in the Harvard text. It appears that this approach may be of value for sophisticated analyses where the numl of units is small but there is also the hope that from the application computer methods to economic factors we may obtain new ideas that might be applied to improve the rational approaches now in use.

The hypotheses of these studies are that "techniques can be devised which will allow planners and engineers to take into account and compare many more alternatives than they do under present practices; and that the consequences of this will be the planning and development of water projects and systems that yield significantly greater profits or benefits. One of the aims is to integrate the work of the engineer and the economist; to integrate the analysis of cost, benefit, and production functions so as to arrive at workable methods for optimum system design. Thus, techniques must be devised for delineating the production function and analyzing it, together with cost and benefit functions, in order to identify the optimum combination."

In order that these idealistic approaches may be utilized it is essential that they be predicated upon sound basic assumptions. One is that adequate data is available to delineate physical, economic, and hydrological quantities for every unit or project over a wide range of values. This is seldom obtainable in practice. Even in our most costly investigations of major basins we cannot afford the additional cost and time. Of necessity, we have had to accept something less and have attempted to do the best we could with minimum essential data.

PRACTICAL APPROACHES

We shall discuss three approaches that vary in concept and present three examples from recent studies that used these approaches either singly or mixed in the screening of alternatives. For these examples the use of reports by the U. S. Army Engineer Districts, Philadelphia, Baltimore and Omaha, and the U. S. Army Engineer Division, Missouri River, is acknowledged.

Steps Common to all Procedures.

Screening of alternatives is the process of preliminary selection and evaluation of a single project or a system of projects to fulfill given needs under specified conditions, criteria and objectives. Therefore any method for screening requires data on: requirements for the goods and services provided by water resources development; the criteria and objectives towards which planning is directed; the conditions and restraints applicable to this planning, and the various possible alternative solutions or projects.

The principles, methods and techniques of establishing the needs in measurable units have been discussed previously. For efficient screening of alternatives the requirements must be tabulated concisely. Three dimensions are needed for each requirement. These are scalar quantity, location, and place in, or variation with, time.

Prior to the screening of alternatives the general objectives of basin planning must be translated into specific criteria or planning policies. Risk levels must be established for flood control, low flow

augmentation, water supply, power production and recreation. Minimum levels acceptable must be set for flood control. Judgment values must be developed for social, esthetical or political effects to include their consideration and a site development policy must be agreed upon. It is the opinion of the authors that underdevelopment at any site, regardless of the outcome of monetary calculations is a tenable solution only in rare cases, that normally the lowest level of development considered for a site should be that obtained by optimization and that every means should be taken to obtain full development.

The adoption of constraints on the free choice of alternatives based on the realities of the basin under study will preclude the expenditure of time and money on completely impractical alternatives and provides a means for reducing the mass of possibilities to more manageable proportions. Constraints adopted at this time however, should be only those that are very certain. Concessions at this early stage to restraints that may not be as unyielding as we may first anticipate may lead to erroneous conclusions. We have reference to a basin in which flood control was the primary objective and the principal benefit values were in a city at the very mouth of the stream. The choice appeared to be between a system of reservoirs, or major channel work within that city. The latter involved intricate and costly relocation of railroads and streets through a congested industrial area. As a result the early conclusion of the planners -- such as we might use in our initial screening -- was to reject the channel plan on the basis that it would be too costly and -- even if it might be found to be economically feasible -- that it would never be accepted by the railroads. What proved to be the case? Further studies were made, the channel plan was recommended and authorized, the opposition of the railroads melted away, and the channel was built. What is disturbing is -- if we had maintained our original position based on a preliminary evaluation (such as we of necessity are doing in our screening) we would have rejected once and for all the channel plan. In a basin offering many more alternatives of choice we might use a "second-best" choice and yet proceed confidently to develop what purports to be the most desirable plan. This risk will be ever present when we must screen on the basis of fragmentary data and limited judgment or allow restraints -- either real or probable -- to influence our decision making. We have no "cure-all" to offer except that if at all times we are aware of the potential problem and take a second look before making the selection we may hope to minimize errors in the screening process.

The final set of data needed for the screening of alternatives is an inventory of projects and significant cost-output relationships for each project. The appraisal of solutions and the principles involved in cost and benefit analyses of alternatives have been treated in previous papers.

From the full array of possible alternative solutions -- and this array should include even the most far-fetched ones -- a preliminary elimination can be made of those methods of solutions that are:

1. Technically not applicable
2. Not sufficiently developed to be used
3. Obviously too expensive

This elimination of types of solutions can be made on the basis of literature research, of experience in similar or neighboring basins, of local conditions or of just common sense.

For those solutions that survive this screening, cost-output relationships for the various purposes singly and in groups must be developed. In the ideal case the same amount of definition should be developed for each purpose and each project and at survey report accuracy. This is far beyond the capability of any organization. Shortcuts must be employed to give preliminary data both in cost and the output area. In reservoir design this might take the form of standardized tabulated design data that can provide a quick estimate on the basis of very meager field and office data.

Order of Merit Approach

The following is abstracted largely from Appendix Q, Formulation of the Plan of Development, Volume IX, of the Delaware River Basin Report, December 1960. The general procedures adopted for that study involved the following steps.

1. Appraisal of basin needs. From detailed studies, including economic base studies, prepare an inventory of basin needs in terms of acre-feet of storage for flood control, kilowatts of power, etc., preferably subdivided to portray area requirements.

2. Inventory of potential projects. Prepare an inventory of major impoundment and development potentials in the basin. Then reduce the number of units in the inventory by elimination of alternatives in the immediate vicinity.

3. Order of Merit. As a practical means of limiting the number of possible combinations to be considered in detail, an "order of merit" for the major impounding sites is then established as a guide in establishing the combinations for detailed study. Its objective is to provide initial groupings of major impounding units to meet future water control needs with some assurance that the groupings would result in balanced water resource development with thrifty investments in productive resources. Also, an order of merit for the sites will identify those sites with such low relative merit that there would be little or no likelihood of their eventual justification. These latter sites are to be avoided in the initial groupings of units into basic plans for further appraisal. (The validity of this assumption is discussed later.)

4. Criteria. A number of criteria, assumptions and details of procedure must be established with the objective of attaining realistic

appraisals of the relative order of merit of the impounding potenti
In order that the relative merit of a particular site will be truly
relative to all other sites the appraisal of the site in question h
to be on an individual basis and in accordance with a set of fixed
standards and procedures. Therefore, the first two criteria provid
that (1) all sites be appraised, as nearly as practicable, by the s
procedures and that (2) each site should be appraised individually
as a solitary unit. Under these criteria any monetary appraisals o
the cost of storage and of the worth of storage for various uses wo
be merely indices of the relative merit of the sites and would have
relation to benefit-cost ratios as normally used.

5. Establish relative order of merit. In view of the nature
the estimates of cost and worth and the limitations imposed by the
assumptions and procedures utilized, it is advisable to reduce this
order of merit to its simplest form. This may be done by expressin
the worth/cost ratio of each project as a fraction of the highest
worth/cost ratio identified with any project under consideration.
worth of each site is based on the estimated values of the products
and effects to be attained from full use of the storage provided an
without adjustments to tailor the products and effects to the needs
the area. Although it is hoped that the relative values for the va
sites will be consistent and in proper relation to each other withi
concepts of this appraisal, they should not be confused with final
appraisals.

6. Select a number of plans. With the order of merit study a
appraisals of basin needs as guides, separate plans of basic storag
and hydropower projects are formulated. (Assuming these are the
principal objectives; if not, the other dominant objectives should
substituted.) The elements included in these plans are selected in
accordance with their relative merit and with the geographic dis-
tribution necessary to meet estimated water supply, recreation, and
flood control requirements in various tributaries and reaches of th
river.

7. Evaluate the products of each plan. To arrive at the best
balanced plan for water resources development to ensure optimum ava
ability of surface water for every use of water, the next step is t
evaluation of the goods and services produced by the several plans
under consideration.

8. Select a basic plan. The monetary values of the products
the costs of their production serve as the basis for selecting from
the several plans a single basic plan to produce, in a balanced man
the needed goods and services with the least investment of water
resources and funds. (This basic plan is not the final plan. In f
where there are conflicting objectives we may require three or more
basic plans be studied and presented for final selection involving

consideration of rigid restraints.) The definition of the basic plan constitutes one of the series of discreet screenings leading to a balanced plan. Further steps are confined to these elements and to additions to, or specific alternatives for, these elements and to additions to, or delections from, the basic plan. The next step is to determine the scale of development for each major impounding project.

9. Dimensions of components. Each of the selected sites is individually analyzed to identify the area of its optimum scale of development in terms of net benefit maximization with consideration given to all water resources products that could be produced by a project at that site. Modifications are then made at each project's optimum level of development so that the scale of development at each site will produce only the resource products for which foreseeable markets exist and where the system net benefits would be a maximum.

10. System Maximization. Before it is possible to choose the final dimensions of any one site to be included within a system it is necessary to re-evaluate each site with respect to its contribution in the attainment of a balanced program of development which could not be fully evaluated within the constraints of the individual site maximization studies.

11. Selection of plan. With the information now available we are ready to proceed to selection of phased plans, establishing of desired planning of construction, etc.

Factors to Watch

1. A selection of values (cost and benefits) that do not distort the formulation. In the Delaware study (discussed later) the benefits for water supply utilized in establishing the order of merit were based upon the average cost of obtaining surface water at other points in the basin even though the final analysis considered the cost of obtaining water from alternate sources such as the ground water aquifer in and adjacent to the basin. If the cost from these alternate sources would be considerably less than from surface impoundments, the water supply benefits attributed to storage would have been overstated in the preliminary screening and we would have injected a bias favoring those reservoirs where water supply was a dominant consideration.

2. Failure of individual components to reflect proportionately in a system. The order of merit is established on the basis of one individual project operating alone. There is no assurance that when this project is incorporated into a system that it will function as efficiently when operated under a system plan as another project that may have been eliminated earlier through the screening process.

3. Influence of scale. In our early screening we may discard a project that would be worthy of retention if the scale had been modified.

Sub-basin Approach.

1. Determine the functional requirements and list (quantitatively - i.e., acre-feet of water supply required, etc.

2. Identify requirements as to location in basin. This will give a breakdown of 1 by sub-basins.

3. Assign preliminary weights to functions in order to prepare a list of order of importance (this should recognize conflicting functions) or establish preliminary and generalized benefit values. Judgment will usually be the important factor as the conventional approach would require detailed value analysis including intangible and secondary values.

4. By inspection of each sub-basin make a site analysis to determine which sites are alternates, i.e., one site could be replaced by three, the three by six, etc. Using general cost data make a rough analysis of cost by tabulating system cost and output. Choose those sites in the sub-basin system with least cost and which meet, or more nearly meet, functional requirements.

5. Repeat for each sub-basin until you have determined all sites for the basin system which, theoretically, meet functional requirements at least cost.

6. Initiate detailed study of each site with objective of maximizing output from each one that meets functional requirements as determined in 3 above. (Some sites may not be able to meet some of the functional requirements.)

7. Tabulate costs for development of each site.

8. At this point, attention should be turned to a basin system composed of sub-basin plans. As a trial, select an operating plan (by trial and error) to determine system output for maximum outputs in order of priorities previously selected.

9. Vary the priorities where a fine line exists between functions and then test various combinations of sub-basin outputs.

10. Evaluate functional benefits.

11. Evaluate costs.

12. Compare 10 - 11 and select the two or three most promising combinations.

13. Refine design, costs, benefits, and operation plan and if necessary prepare alternates that reflect political and legal restraints.

Comments

This plan differs from "order of merit" primarily in that only small groups are analyzed at one time. Step 4 is generally comparable to the "order of merit" and might be considered as a variation. Inclusion of Step 3 overlaps to some extent the concept of the "functional approach" described in the next section. There are, however, instances where this may become a paramount consideration as, for example, in one reach of a stream where there may have to be a choice between reservoir development of any kind as contrasted to preserving a scenic attraction of national importance in its undisturbed state. In such a case we would want to ensure that we have alternatives for our basic plan that did not require development of that reach.

Functional Approach.

This is of value primarily when either of the following conditions exist:

1. Analysis of needs indicates that a definite priority for development of several of the functions is logical.

2. There is a great disparity in values that can be attributed to use of water for different functions. For example, the value of an acre-foot of storage for irrigation may be ten times the value for flood control. This would mean that in any approach directed toward maximization of benefits, irrigation considerations would govern and therefore the initial screening could be simplified.

Method

1. By generalized methods determine approximate costs of storage at each site.

2. Determine storage requirements to meet the primary need.

3. Select sites to meet aggregate storage.

4. Modify system to maximize benefits.

5. By "trial and error" add in projects or increase size of units to meet subordinate functions.

6. Proceed as in Step 13 of "Sub-basin Approach".

Delaware Basin

One of the best known examples of application of the "order of merit" procedure was the formulation of the plan of development for the Delaware River Basin. The procedure required that the plan for balanced development of the water resources of the basin be defined, basically, in terms of major impounding measures with other types of measures studied as desirable additions to assure an optimum level of development in keeping with the planning goals.

1. Appraisal of Basin Needs. The analysis of the needs for the products of water control was obtained following separate studies of future gross and net water demands; damages from flooding, electric power market; requirements for hunting, fishing and recreation opportunities; agriculture; water quality, navigation; and an economic base survey. This resulted in tabulations of net surface water requirements in water problem areas, estimated future power requirements, recreation needs expressed by types in man-days, etc.

2. Inventory of Potential Projects. In the case of the Delaware, prior studies had indicated that with few exceptions the needs "derive from excesses and deficiencies of surface water supplies and from a dearth of developable surface waters at favorable localities for water based activities." Therefore an inventory was made of all potential sites having the capability of impounding or regulating surface waters. They ranged from small detention reservoirs in the immediate upstream areas to major impounding reservoirs on the principal water courses. They included provision for both "short-term" and "long-term" storage. The number of units in the inventory was then reduced by elimination of alternatives in the immediate vicinity. In the Delaware this preliminary screening reduced the number of major reservoir sites to be considered from 193 to 70.

3. Criteria. Basic criteria were established. These included the two basic criteria cited in Step 4 of "order of merit."

4. Establish Relative Order of Merit. While the order of merit was established primarily on the basis of comprehensive development of each site to provide both short-term and long-term storage for several project purposes, the procedures followed also permitted orders of merit for the sites developed only for short-term storage. The orders of merit for the three types of development are shown in Table 1, Page 378, together with pertinent data on drainage areas and impoundment capacities.

5. Select a Number of Plans. Nine plans, five of which were designed to do essentially the same job were developed. The other four

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TABLE 1

ORDER OF MERIT FOR MAJOR IMPOUNDING POTENTIALS

Proj. Index No.	Project	Drainage Area Square Miles		Comprehensive Development Long-Term & Short-Term Storage				Development of Long-Term Storage Only				Development of Short-Term Storage Only				Remarks
		Gross	Net (a)	Storage (ac.ft.)	Annual Worth (b) $1000	Annual Cost (b) $1000	Order of Merit	Storage (ac.ft.)	Annual Worth $1000	Annual Cost $1000	Order of Merit	Storage (ac.ft.)	Annual Worth $1000	Annual Cost $1000	Order of Merit	
33	Tohickon	75		62,000	2,764	940	1	33,600	2,763	865	2	29,600	1.0	470	45	
30	Tocks Island	3,827	3,004	635,000	13,475	4,660	2	635,000	15,765	4,660	1	420,000	1,110.0	1,820	2	
51	New Hampton	123		45,000	2,884	1,168	3	45,000	2,884	1,168	7	45,000	63.6	723	28	Capacity limited by geography
67	Buck Run	47		42,000	2,672	1,092	4	22,400	2,642	1,024	4	20,400	30.0	452	35	
70	Christiana	41		40,000	1,938	798	5	40,000	2,000	798	5	17,000	7.5	287	40	
68	New Castle	306		206,000	5,290	2,205	6	112,300	5,210	1,962	3	96,300	80.4	1,005	31	
29	Flat Brook	65		248,000	4,243	1,812	7	22,500	1,842	755	8	26,000	91.0	450	16	
69	Newark	68		57,600	1,940	870	8	30,600	1,930	775	6	27,600	10.0	360	39	
50	Hackettstown	70		51,000	1,917	932	9	26,600	1,853	817	10	28,100	63.6	455	21	
28	Wallpack Bend	3,735	2,912	372,000	9,358	4,700	10	372,000	10,283	4,700	12	372,000	1,000.0	3,315	9	
66	Evansburg	54		47,000	2,711	1,371	11	25,500	2,675	1,199	11	22,500	36.0	611	37	
64	French Creek	47		42,000	1,878	1,020	12	22,400	1,842	881	13	20,400	36.0	447	30	
36	Sarento	33		23,000	1,369	750	13	8,700	1,262	646	16	15,000	76.8	279	11	
25	Bridgeville	160	67	78,000	1,175	728	14	23,000	1,046	449	9	56,000	128.0	410	8	
33	McMichael	63		45,000	1,233	764	15	20,500	1,180	658	18	25,500	52.8	450	26	
17	Shohola Falls	59		42,000	693	452	16	18,500	598	306	15	24,000	94.8	228	7	
44	Beltzville	97	75	61,000	1,223	803	17	25,600	915	680	28	36,600	308.4	593	3	
57	Newtown	150		113,000	3,124	2,187	18	61,200	3,060	1,562	14	53,200	63.6	1,080	38	
1	Hawk Mountain	812	440	403,000	2,983	2,088	19	293,000	3,350	1,875	19	218,000	348.0	1,605	14	
27	Girard	58		42,000	1,489	1,110	20	18,500	1,398	960	23	24,000	91.2	568	20	
38	Tobyhanna	224		86,700	1,255	935	21	86,700	1,255	935	29	-	-	-	47	Short-term storage existing d.s.
65	Spring Mountain	274	206	164,000	3,045	2,300	22	79,600	2,858	1,886	21	86,600	187.0	1,535	25	
46	Trexler	51		44,000	720	547	23	24,400	584	425	25	20,400	136.0	310	6	
61	Bernville	129		112,000	1,433	1,106	24	53,000	1,372	913	22	60,000	61.2	737	29	
34	Paulina	122		95,000	2,203	1,730	25	51,000	2,150	1,194	17	45,000	52.8	828	36	
19	Knights Eddy	2,834	2,011	1,300,000	10,082	8,472	26	1,300,000	13,360	8,472	20	500,000	1,122.0	5,310	15	
63	Fancy Hill	64		54,000	1,329	1,132	27	29,500	1,279	938	27	25,500	50.4	687	43	
37	Pequest	100		75,000	1,334	1,187	28	38,800	1,250	865	24	37,800	83.6	660	24	
26	Basher Kill	3,102	2,186	1,285,000	14,863	13,505	29	1,285,000	15,715	13,505	31	-	-	-	48	Includes diversion from Barryvill
49	Washington	13		9,000	343	318	30	2,200	343	248	26	6,900	1.0	221	44	
45	Aquashicola	66		56,000	750	700	31	30,600	490	573	40	26,600	260.0	501	4	
43	Mahoning	538		231,000	2,628	2,500	32	215,000	2,514	2,430	35	17,000	114.0	259	5	Includes diversion from Lehigh R.
13	Hawley	80		59,700	1,221	1,180	33	28,700	1,108	971	32	31,700	113.0	810	22	
62	Monoc	23		22,800	474	467	34	12,200	452	359	30	10,800	21.6	271	33	
15	Sterling	143		50,200	400	395	35	-	-	-	47	50,200	400.0	395	1	Existing long-term storage d.s.
48	Belfast	46		32,000	1,253	1,248	36	13,400	1,183	1,078	33	19,400	69.6	890	34	
60	Moselem	176		135,000	1,648	1,660	37	69,400	1,548	1,437	34	67,400	99.6	1,247	32	
5	Callicoon	111		84,900	837	905	38	44,900	645	715	38	40,900	192.0	650	10	
16	Lackawaxen	595	367	176,000	2,663	3,029	39	176,000	2,070	3,029	42	167,800	502.0	2,872	19	
56	Crosswicks	94		31,600	659	752	40	31,600	659	752	39	31,600	1.0	667	46	Capacity limited by geography
31	Pine Mountain	67		48,000	876	1,044	41	22,000	795	770	36	27,000	80.4	678	27	
32	Bartonville	39		27,000	510	653	42	10,300	430	424	37	17,300	80.4	440	18	
59	Bayrestown	146		15,000	472	659	43	15,000	472	659	41	15,000	10.0	589	41	Capacity limited by geography
58	Birmingham	121		12,200	443	707	44	12,200	443	707	43	12,200	10.0	622	42	Capacity limited by geography
2	Cannonsville	450		185,000	401	826	45	-	-	-	48	185,000	181.0	826	13	Long-term storage existing at si
8	Milanville	46		32,400	259	648	46	13,400	159	443	44	19,400	100.0	507	17	
3	Equinunk	59		42,000	316	979	47	18,500	214	668	45	24,000	102.0	760	23	
12	Masthope	29		20,300	196	610	48	7,300	96	381	46	13,300	100.0	452	12	

(a) Less area above existing reservoirs upstream.

(b) The worth and cost of hydropower potentials of the Hawk Mtn., Knights Eddy, Wallpack Bend, Tocks Island, Lackawaxen, Shohola Falls, Basher Kill, Flat Brook, Tobyhanna and Beltzville sites were considered in studies reported in Appendix T.

included Plan "F" to maximize hydropower development, Plan "G" directed toward recreation development, Plan "H" to provide optimum water supply and low flow regulation, and Plan "K" composed primarily of potential pumped storage hydropower projects with some added storage for flood control and water supply. Since Plans F, G, H and K were not comprehensively designed to assure a balanced plan of development they were utilized primarily in considering modifications of the other plans. Because of geographic locations, project dimensions, and other factors, it was not possible to formulate the plans to do exactly the same job with precisely the same degree of development of the resources.

The necessary geographic distribution required that the five plans include elements that were found in the order of merit study to have relatively low merit when compared with other potential sites in the basin.

In the five basin plans the elements were arranged in two phases of construction periods. Phase 1 would provide substantial relief from existing flood losses and meet requirements for water supply to the year 1980. The elements of Phases I and II were designed to meet the water supply needs to the year 2010. (At a later date the two-phase timing was abandoned and a more accurate fixing of construction times utilized.) The elements of Phase I are shown in Table 2, page 380, for illustrative purposes.

6. Evaluate the Products of Each Plan. Detailed studies were made to evaluate the products of each plan.

7. Basic plan selected. The values of the products and effects of each plan are listed in Table 3, page 381, together with estimates of the cost of production of each plan. (The headings STORAGE represent joint values and the others represent specific values and costs.)

During considerations to define the basic plan for the Delaware it was realized that the exclusion of apparent high merit sites from the basic plan would be questioned. Such results may be inevitable in the definition of a balanced plan for the optimum development of any sizeable basin having a complex regional economy. The required geographic distribution, system operations, economics of size, and appraisal limitations, may all contribute to such results. The situation can be attributed generally to fundamental difficulties inherent in a unit-cost-type study such as the "order of merit" study.

Review indicated that there was little likelihood of obtaining the widespread economic development of hydropower in connection with any plan except Plan K. Accordingly, the approximate net excesses of benefits were determined for Phase I without power. This then indicated that the choice lay between Plans A and H. Plan H involved over-production and expensive sites leading to a preliminary selection of Plan A. In order to obtain the excess net values of Plan K it was necessary that those elements of Plan K not included in Plan A be retained. This gave eight major impounding projects for the initial phase.

TABLE 2

ELEMENTS OF PHASE I OF PLANS A, B, C, D, E, F, G, H AND K

Project	Gross Drainage Area (sq.mi.)	PLAN A Storage 1000 acre feet			PLAN B Storage 1000 acre feet			PLAN C Storage 1000 acre feet			PLAN D Storage 1000 acre feet			PLAN E Storage 1000 acre feet			PLAN F Storage 1000 acre feet			PLAN G Storage 1000 acre feet			PLAN H Storage 1000 acre feet			PLAN K Storage 1000 acre feet		
		Long Term	Short Term	Total	Long Term	Short Term	Total	Long Term	Short Term	Total	Long Term	Short Term	Total	Long Term	Short Term	Total	Long Term	Short Term	Total	Long Term	Short Term	Total	Long Term	Short Term	Total	Long Term	Short Term	Total
Hawk Mountain	812.				293.0	112.0	405.0							293.0	112.0	405.0												
Hankins	1,645.				3.5	-	3.5							3.5	-	3.5												
Callicoon	1,709.				13.0	-	13.0							13.0	-	13.0												
Skinners Falls	1,901.				1.2	-	1.2							1.2	-	1.2												
Tusten	1,978.				3.0	-	3.0							3.0	-	3.0												
Sterling	143.	1.5	49.0	50.5	1.5	49.0	50.5	1.5	49.0	50.5	1.5	49.0	50.5	1.5	49.0	50.5				1.5	49.0	50.5	1.5	49.0	50.5			
Lackawaxen	595.																63.0	80.0	143.0									
Shohola Falls	59.										20.0	20.0	40.0													20.0	20.0	40.0
Hawks Nest	3,046.				10.0	-	10.0							10.0	-	10.0												
Basher Kill	326.																									600.0	100.0	700.0
Girard	58.										19.0	20.0	39.0															
Wallpack Bend	3,735.																120.0	252.0	372.0	162.0	210.0	372.0						
Flat Brook	65.																			52.0	-	52.0				280.0	20.0	300.0
Tocks Island	3,827.	335.0	300.0	635.0				335.0	300.0	635.0													335.0	300.0	635.0	335.0	300.0	635.0
McMichaels	63.				20.5	21.0	41.5				20.5	21.0	41.5	20.5	21.0	41.5							20.5	21.0	41.5			
Paulina	122.										54.0	-	54.0															
Belvidere	4,365.	31.0	-	31.0				31.0	-	31.0							31.0	-	31.0	31.0	-	31.0	31.0	-	31.0			
Pequest	100.										41.0	-	41.0															
Chestnut Hill	4,640.	11.0	-	11.0				11.0	-	11.0							11.0	-	11.0	11.0	-	11.0	11.0	-	11.0			
Tobyhanna	224.	87.0	-	87.0	87.0	-	87.0				87.0	-	87.0	87.0	-	87.0	142.0	-	142.0				87.0	-	87.0	142.0	-	142.0
Mud Run #1	32.	28.5	-	28.5	28.5	-	28.5				28.5	-	28.5	28.5	-	28.5	28.5	-	28.5				28.5	-	28.5	28.5	-	28.5
Stony Creek #2	6.	8.0	-	8.0	8.0	-	8.0				8.0	-	8.0	8.0	-	8.0	8.0	-	8.0				8.0	-	8.0			
Bear Creek #3	4.	12.6	-	12.6	12.6	-	12.6				12.6	-	12.6	12.6	-	12.6	12.6	-	12.6				12.6	-	12.6	12.6	-	12.6
Mahoning	(a) 538.							217.5	-	217.5										217.5	-	217.5	217.5	-	217.5			
Beltsville	97.																									26.3	31.0	57.3
Aquashicola	66.							31.0	22.0	53.0													31.0	22.0	53.0			
Trexler	51.							24.8	17.0	41.8													24.8	17.0	41.8			
Hackettstown	70.										24.0	-	24.0							24.0	-	24.0						
New Hampton	123.										42.0	-	42.0							42.0	-	42.0						
Holland	6,357.	53.0	-	53.0				53.0	-	53.0							53.0	-	53.0	53.0	-	53.0	53.0	-	53.0			
Tohickon	75.				34.5	-	34.5				34.5	-	34.5	34.5	-	34.5				34.5	-	34.5	34.5	-	34.5			
Eagle Island	6,627.	20.7	-	20.7				20.7	-	20.7							20.7	-	20.7	20.7	-	20.7	20.7	-	20.7			
Goat Hill	6,692.	4.7	-	4.7				4.7	-	4.7							4.7	-	4.7	4.7	-	4.7	4.7	-	4.7			
Yardley	6,740.																5.0	-	5.0									
Crosswicks	94.																			31.6	-	31.6						
Newtown	150.										62.0	-	62.0	62.0	-	62.0				62.0	-	62.0	62.0	-	62.0			
Berwville	129.	53.0	41.0	94.0	53.0	41.0	94.0	53.0	41.0	94.0	53.0	41.0	94.0	53.0	41.0	94.0	53.0	41.0	94.0	53.0	41.0	94.0	53.0	41.0	94.0	53.0	41.0	94.0
French Creek	47.										23.3	15.7	39.0	23.0	15.7	39.0							23.3	15.7	39.0			
Evansburg	54.										26.5	18.5	45.0	26.5	18.5	45.0							26.5	18.5	45.0			
Buck Run	47																						23.0	-	23.0			

(a) 37 sq. mi. on Mahoning Cr. and 501 sq. mi. diversion from Lehigh River

TABLE 3

VALUES OF PRODUCTS AND COSTS OF THEIR PRODUCTION FOR THE PLANS UNDER CONSIDERATION

PLAN	ANNUAL VALUE OF PRODUCTS - $1,000,000					ANNUAL COST OF PRODUCTION - $1,000,000					Net Excess (5)-(10)
							Specific Costs				
	Storage	Recrea-tion	Fish and Wildlife	Hydro-power	Total	Storage	Recrea-tion	Fish and Wildlife	Hydro-power	Total	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
					PHASE I						
A	6.2	8.8	.4	9.9	25.3	5.2	5.9	.6	14.0	25.7	- 0.4
B	5.9	3.2	.3	6.0	15.4	5.5	2.1	.3	11.5	19.6	- 4.2
C	8.4	8.6	.4	7.2	24.6	8.2	5.8	.6	9.1	23.7	+ 0.9
D	5.7	11.7	.2	3.1	20.7	9.4	10.7	.8	5.5	26.4	- 5.7
E	7.0	9.8	.3	6.0	23.1	7.9	6.2	.7	11.5	26.3	- 3.2
F	5.2	8.8	.03	9.0	23.0	8.2	5.9	.5	14.0	28.6	- 5.6
G	7.7	20.1	.4	5.2	33.4	11.8	13.5	.8	7.6	33.7	- 0.3
H	11.2	20.4	.5	10.5	42.6	12.8	13.4	1.1	14.5	41.8	+ 0.8
K	10.9	10.3	.2	33.1	54.5	20.1	6.9	.7	16.6	44.3	+10.2
					PHASE II						
A	7.3	9.5	.3	5.0	22.1	8.9	6.1	.7	7.6	23.3	- 1.2
B	8.1	16.0	.4	8.6	33.1	9.6	10.5	.8	10.0	30.9	+ 2.2
C	6.2	7.8	.3	5.1	19.4	7.0	5.0	.6	7.8	20.4	- 1.0
D	19.9	11.9	.5	19.4	51.7	22.9	7.9	1.0	14.2	46.0	+ 5.7
E	13.4	9.7	.5	11.5	35.1	12.9	8.0	.8	12.4	34.1	+ 1.0
F	9.8	10.2	.5	3.4	23.9	11.1	6.6	.6	2.6	20.9	+ 3.0
G	11.3	12.8	.2	4.4	28.7	16.7	8.2	.8	3.3	29.0	- 0.3
H	5.7	7.6	.2	4.5	18.0	6.4	4.8	.5	6.7	18.4	- 0.4
					PHASE I + II						
A	13.5	18.3	.7	14.9	47.4	14.1	12.0	1.3	21.6	49.0	- 1.6
B	14.0	19.2	.7	14.6	48.5	15.1	12.6	1.3	21.5	50.5	- 2.9
C	14.6	16.4	.7	12.3	44.0	15.2	10.8	1.2	16.9	44.1	- 0.1
D	25.6	23.6	.7	22.4	72.4	32.3	18.6	1.8	19.7	72.4	0.0
E	20.4	19.5	.8	17.5	58.2	20.8	14.2	1.5	23.9	60.4	- 2.2
F	15.0	19.0	.5	12.4	46.9	19.3	12.5	1.1	16.6	49.5	- 2.6
G	19.0	32.9	.6	9.6	62.1	28.5	21.7	1.6	10.9	62.7	- 0.7
H	16.9	28.0	.7	15.0	60.6	19.2	18.2	1.6	21.2	60.2	+ 0.4

In subsequent review all pumped-storage power projects were rejected. A second look was then taken at recreation. It was noted that there was a great deal of similarity between Plans A and H when all elements were considered. The second phase was then formed to include the Phase II elements of Plan A plus four of the seven additional impounding projects in various parts of the basin included in Plan H. This gave a second phase providing for fifteen major impoundments.

8. Dimension of Components. Each of the sites was then analyzed to maximize net benefits for each major site. Plates were prepared showing the range of net benefit accrued at each site with respect to a series of short-term and long-term allocations. It was discovered that it was feasible to make modifications in the scale of development at any one site from the maximized level without seriously altering the maximized net benefit estimate. This zone of maximization permitted the necessary scale of development changes at each site to achieve a balanced program without seriously violating the maximization principles.

9. System Maximization. It was necessary to re-evaluate each site with respect to its contribution in a balanced system without the constraint of the individual site maximization studies. This re-evaluation considered:

a. The degree of flood control protection to be afforded from each site in relation to the desirable levels of production indicated by the other criteria and

b. The adequacy of the several projects considered as a system in meeting the 50-year requirements for water supply.

The goal was not only to provide bases for fixing the dimension of the individual projects within the realities of the planning environments but also to establish storage allocations designed to optimize, within practical limits, the net benefits. The effect can be gaged by one study (of seven reservoirs) showing an overall reduction of 8 percent in net benefits from the maximum established by the individual maximization studies.

10. Further studies were then directed toward sequencing and timing of projects and selection of the final plan. The final plan, including the upstream reservoirs, included 65 impoundments. It also indicated the other programs -- such as collection of water quality data, waste removal, flood plain land use, research, and management that were considered essential to the attainment of a comprehensive plan.

The Potomac Basin.

In the analysis of the Potomac Basin two facts are mostly responsible for the methods chosen for screening of alternatives. The first fact

was the large number of points of needs distributed over the main stem, the major and minor tributaries. This eliminated the order of merit approach because it was not feasible to establish such an order. A different order would be needed for each needs point; this would be true even for those occurring in series along the river. The sub-basin method was therefore more applicable particularly for the branches in the dentritic pattern.

The second fact was the realization early in the study that low flow augmentation for water supply and water quality control would provide half or more of all the benefits, that flood control by itself was uneconomical in almost all areas, and that hydroelectric power generation was ruled out as a dominant project purpose by congressional action. This made low flow control the most important factor and this dominance recommended the functional method.

The actual method used was a hydrid of the sub-basin and the functional approach and was applied as follows:

After establishing needs, possible solutions and necessary criteria, the preparation of alternative plans was undertaken. Plans were developed for special areas, for special purposes and for basin-wide multiple purpose coverage.

1. Screening of Solutions. An analysis and comparison of the types of solutions available indicated in general terms the elements required in any water resources development plan for the Potomac River Basin. For water supply, reservoir storage of surface water was the principal solution. Groundwater was found available only in portions of the basin, and in limited quantities. This would supply only part of the needs in these portions, and at a cost several times greater than comparable surface water supplies from reservoirs. Its use, therefore, would be generally restricted to relatively small local communities and individual home or farm supplies. The somewhat larger groundwater resources in the coastal Plain should be reserved for the use of the coastal area. This area has inadequate surface water resources, and depends almost completely on groundwater. Desaltation was not an economical alternative. Such facilities would have a high construction cost, and would likely place a severe burden on available energy resources. Diversion did not qualify as a reasonable alternative. The cost of developing the required surface water facilities in adjacent basins, plus the high cost of transmission to needs centers in the Potomac Basin, makes this a very expensive solution. Even at high cost, major quantities of water, in excess of that already preempted for other uses, are not available in these nearby basins. Weather modification and complete recirculation have not reached a stage of development which assures satisfactory results, even in the research stage. Curtailment of use, other than prudent utilization of water without undue waste, does not fit into the expected development pattern in the Potomac Basin and is not a realistic solution. The exception to this is the use of water for industrial cooling. Here, a practical and economical alternative exists in the use of cooling ponds and towers.

Therefore, cooling water needs are not a requirement that must be met by river development. On the other hand, where water is made available for other purposes, its use as cooling water is compatible with other uses, less expensive than cooling ponds or towers, and, therefore, an added benefit to development.

As stated in the conclusions of the U. S. Public Health Service, dilution is the only practical method available to maintain water quality after adequate primary and secondary treatment of wastes at their source. Lagooning can handle only small waste loads. Tertiary treatment, special treatment and distillation are not practical or economical solutions. Diversion to different receiving bodies, however, is an important adjunct to dilution in some areas. Where the treated waste can be routed into a receiving body of water large enough to assimilate it by natural processes, at a lower cost than by providing additional water near the residual waste source, diversion is an economical and practical alternative.

In the field of flood control, analyses of the possible solutions showed that local protection works can be used in some places and that protection by storage in reservoirs was feasible only where they are needed for other purposes. Flood control thus shares in the cost of such reservoirs. The choice of flood control solutions was made on the basis of economics and the type of protection most suitable to each individual damage reach. Flood plain zoning was considered a tool of local government to reduce the growth of development in areas subject to flooding and to reduce damages in presently developed areas where protection is not technically or economically feasible.

Water is a focal point for outdoor recreation, but outdoor recreation can exist without water development. Parks, wilderness areas, land, streams and shores provide for outdoor recreation, fishing and hunting. Therefore, recreation was not considered a purpose for which major developments should be initiated. On the other hand, where projects for other purposes are required, the recreation potential of these projects should be fully developed and recreation treated as a co-equal purpose.

The entire hydroelectric power potential of the Potomac River system, estimated to be about 700,000 kilowatts, is only about one percent of the nearly 70 million kilowatts of anticipated power demand for the year 2010.

The development of this hydroelectric power potential was not one of the purposes specifically stated in the study authorization. Water resources development to meet fully the four purposes stated in the authorization would preclude full efficiency of power operations in any selected reservoir site. However, development of hydroelectric power as an adjunct to the other four purposes was reviewed and is possible. When considered as an adjunct, and operated without detriment to the other purposes, the excess power benefits over power cost resulting from such power development would be small. Although power

development was not recommended at this time, the power potential of the river, however, small, will be preserved for the future in a manner compatible with development for other purposes.

Land management and conservation measures were considered a vital adjunct to any plan for basin-wide or local development.

2. The General Plan. Any plan for the Potomac Basin that is capable of implementation and economically feasible will contain basically some or all of the following:

Maximum practicable degree of waste treatment.
Reservoir storage for regulation of dependable flows for water supply and water quality control.
Reservoir storage for flood control
Local flood control measures where economically feasible.
Maximum economical development of the recreation potential of project lands and waters through provision of specific facilities for recreation and multiple use of facilities required for other purposes.
Continuation and expansion of current land management and conservation programs.
Prosecution of programs for controlling and regulating the use and development of flood plains where other means of flood control are not economically feasible.

A preliminary selection of reservoir projects was required in order to provide basic data for establishment and evaluation of plans.

3. Selection and Screening of Major Reservoir Projects. Major reservoir sites were selected in the preliminary phase from map studies. This selection was based primarily on topography, but consideration was also given to selection of those sites having an apparent storage potential and an acceptable dam site. Subsequently, field visits to each site were made by engineers and geologists. This reconnaissance provided information on possible engineering and geological problems which could be encountered, cultural development in the reservoir areas, and general attributes of the sites. Storage capabilities were developed in engineering studies, along with the relationships between storage capacity and structure size, and preliminary cost information. Those sites having obvious defects such as unsuitable geologic conditions, excessive costs or relocations and extremely poor cost to storage relationships were eliminated from further consideration. In this manner, 207 sites were analyzed and compared. These sites are listed in Table 4, (pages 386 & 387) together with the most significant data that caused their retention or rejection in the two preliminary stages of analysis.

TABLE 4

SUMMARY OF PRELIMINARY ANALYSIS OF MAJOR RESERVOIRS
POTOMAC RIVER BASIN

Location			First Review				Second Review				
					Range of Storage		Range of Cost				
Stream	No.[1]	Drainage Area Sq. Mi.	Disposition	Reason for Elimination	Max Ac-Ft	Min Ac-Ft	Min Cost[2]	Max Cost	Disposition	Remarks
Evitts Creek	1	83	Eliminated	Extensive suburban development	-	-	-	-	-	-
Patterson Cr.	1	270	Retained	-	270,000	60,000	85	246	Retained	-
"	2	95	Retained	-	73,000	23,000	171	297	Retained	-
"	3	27	Eliminated	High cost for small storage	-	-	-	-	-	-
"	4	183	Retained	-	190,000	60,000	111	188	Retained	-
"	5	64	Retained	-	38,100	11,500	321	511	Eliminated	High cost for storage
"	6	219	Retained	-	140,000	65,000	77	107	Retained	Headsville project
South Branch Potomac	1	179	Retained	-	91,000	18,000	198	420	Retained	Retained for Franklin
"	2	230	Retained	-	72,500	28,000	216	350	Eliminated	Smaller, more expensive than 4
"	3	289	Retained	-	48,500	10,500	279	571	Eliminated	" " " " "
"	4	314	Retained	-	140,000	52,500	160	205	Retained	-
"	5	274	Retained	-	115,000	22,500	148	374	Retained	-
"	6	280	Eliminated	High cost for storage provided	-	-	-	-	-	-
"	7	640	Retained	-	257,500	130,000	104	132	Retained	Royal Glen project
"	8	150	Retained	-	83,000	9,000	107	386	Eliminated	Smaller, more expensive than 11
"	9	160	Eliminated	Unsatisfactory geology	-	-	-	-	-	-
"	10	1480	Eliminated	Alternate 10-A is more economical	-	-	-	-	-	-
"	10-A	1486	Retained	-	970,000	430,000	82	127	Retained	Springfield project
"	11	263	Retained	-	145,000	70,000	100	116	Retained	-
"	12	95	Retained	-	47,000	13,000	169	489	Eliminated	High cost for storage
"	13	65	Retained	-	30,000	11,000	244	391	Eliminated	High cost for storage
"	14	85	Eliminated	Excessively long dam with excessive costs	-	-	-	-	-	-
"	15	44	Retained	-	43,300	7,300	189	636	Eliminated	High cost for storage
"	16	62	Retained	-	31,000	10,000	353	535	Eliminated	High cost for storage
"	17	32	Retained	-	17,300	6,500	402	670	Eliminated	High cost for storage
"	18	68	Eliminated	Narrow & steep valley including Onego, W.Va.	-	-	-	-	-	-
"	19	74	Eliminated	Too steep for economical storage	-	-	-	-	-	-
"	20	73	Retained	-	50,000	7,700	336	358	Eliminated	High cost for storage
"	20-A	97	Retained	-	71,000	10,000	220	514	Eliminated	High cost for storage
"	21	50	Retained	-	30,000	3,300	333	1312	Eliminated	High cost for storage
"	22	1320	Retained	-	76,000	-	181	-	Eliminated	Extensive relocations, more expensive than 10-A
"	23	36	Eliminated	Too steep for economical storage	-	-	-	-	-	-
"	24	161	Retained	-	93,000	13,000	238	561	Eliminated	High cost for storage
"	25	309	Retained	-	187,500	55,000	139	228	Eliminated	More expensive than 7
Little Cacapon	1	101	Retained	-	78,000	35,500	68	97	Retained	Little Cacapon project
Cacapon	2	46	Retained	-	25,000	7,500	191	392	Eliminated	Site No. 1 is cheaper
Fifteen Mile Creek	1	60	Retained	-	42,000	9,800	305	474	Eliminated	High cost for storage
Sideling Hill Creek	1	100	Retained	-	70,000	24,500	130	199	Retained	Sideling Hill project
	2	58	Eliminated	Well developed steep valley	-	-	-	-	-	-
Cacapon	1	679	Retained	-	411,900	106,500	77	138	Retained	Edes Fort project
"	2	625	Retained	-	310,000	55,000	72	133	Retained	-
"	3	393	Retained	-	255,000	85,000	89	195	Retained	-
"	4	185	Retained	-	135,000	55,000	113	124	Eliminated	No local needs, more expensive than lower sites for downstream needs.
"	5	296	Retained	-	120,000	43,000	113	273	Eliminated	Lower sites cheaper
"	6	157	Retained	-	118,000	15,000	106	494	Eliminated	Site No. 6-A is cheaper
"	6-A	157	Retained	-	118,000	15,000	94	454	Retained	-
"	7	91	Retained	-	56,000	17,500	179	331	Eliminated	Lower sites are cheaper
"	8	53	Retained	-	28,500	15,000	288	382	Eliminated	6-A is cheaper
Little Tonoloway Creek	1	25	Retained	-	15,800	7,000	306	555	Eliminated	High cost for storage
Tonoloway Creek	1-A	108	Retained	-	76,000	20,000	150	249	Eliminated	Site No. 1 is cheaper
"	1	107	Retained	-	91,500	46,200	120	163	Retained	Tonoloway Creek project
"	2	39	Retained	-	17,500	5,300	307	472	Eliminated	Site No. 1 is cheaper
"	3	23	Retained	-	12,200	5,700	208	334	Eliminated	Site No. 1 is cheaper
Sleepy Creek	1	133	Retained	-	97,000	13,000	121	401	Retained	Retained for possible off-stream storage
"	2	87	Retained	-	66,000	27,000	116	185	Eliminated	No local needs
"	3	18	Eliminated	High cost for small storage	-	-	-	-	-	-
Licking Creek	1	154	Retained	-	84,000	35,000	101	169	Retained	Licking Creek project
"	2	83	Retained	-	57,000	19,000	148	271	Eliminated	Site No. 1 is cheaper
"	3	58	Retained	-	31,000	8,000	220	294	Eliminated	Site No. 1 is cheaper
Back Creek W. Va.	1	247	Retained	-	157,000	43,000	96	168	Eliminated	Site No. 3 is cheaper
" "	2	174	Retained	-	38,000	15,000	138	244	Eliminated	Site No. 3 is cheaper
	3	231	Retained	-	185,000	82,000	77	123	Retained	North Mountain project
Conocochaugue Creek	1	327	Retained	-	290,000	164,000	98	139	Retained	-
	2	78	Retained	-	51,500	17,500	159	290	Retained	West Branch project
"	3	236	Eliminated	Extensive relocation cost	-	-	-	-	-	-
"	4	186	Eliminated	Unsatisfactory geology and severe relocation	-	-	-	-	-	-
"	5	63	Retained	-	66,700	21,500	149	293	Retained	Back Creek, Pa., project
"	6	118	Retained	-	29,000	14,300	288	464	Retained	Chambersburg project
"	7	484	Eliminated	Extensive relocation cost & topo. limitations	-	-	-	-	-	-
Town Creek	1	193	Retained	-	76,000	11,000	130	322	Eliminated	Site No. 4 is cheaper
"	2	64	Retained	-	42,000	8,000	210	397	Eliminated	" " " " "
"	3	34	Retained	-	15,500	3,500	250	680	Eliminated	" " " " "
"	4	153	Retained	-	88,000	40,800	112	157	Retained	Town Creek project
Antietam Creek	1	290	Eliminated	Extensive highway & railroad relocation	-	-	-	-	-	-
	2	90	Retained	-	56,000	46,000	267	293	Eliminated	Extensive relocations, poor geology
"	3	126	Eliminated	Inundates Lestersburg, Md.	-	-	-	-	-	-
"	4	237	Eliminated	Topographic limitations	-	-	-	-	-	-
Opequon Creek	1	345	Retained	-	105,000	83,000	265	353	Eliminated	High cost & lack of needs
"	2	274	Retained	-	197,000	60,000	126	173	Retained	-
"	3	215	Eliminated	Poor geology and severe relocations	-	-	-	-	-	-
"	4	111	Retained	-	83,000	35,500	113	172	Retained	Winchester project
"	5	39	Retained	-	27,500	18,000	272	314	Retained	-
Shenandoah River	1	3,030	Retained	-	1,100,000	170,000	68	156	Retained	-
"	2	2,999	Retained	-	809,000	89,600	65	160	Retained	Kabletown project
"	3	2,960	Retained	-	423,000	116,000	91	199	Eliminated	Site No. 2 is cheaper
"	4	2,900	Retained	-	440,000	139,000	86	179	Retained	Berryville project
"	5	1,095	Retained	-	231,700	82,500	146	218	Retained	-
"	6	90	Retained	-	54,000	22,000	200	267	Retained	-
"	7	780	Eliminated	Topographic limitations	-	-	-	-	-	-
"	8	730	Retained	-	178,000	43,000	81	136	Retained	-
"	9	560	Eliminated	Topographic limitations	-	-	-	-	-	-
"	10	560	Eliminated	Topographic limitations	-	-	-	-	-	-
"	11	105	Retained	-	19,500	9,000	370	512	Eliminated	More expensive than 12
"	12	73	Retained	-	45,000	16,800	260	385	Retained	-
"	13	110	Retained	-	35,200	2,700	270	1,170	Eliminated	High cost for storage
"	14	345	Eliminated	Topographic limitations & relocations	-	-	-	-	-	-
"	15	76	Eliminated	Site No. 13 is more economical	-	-	-	-	-	-
"	16	220	Retained	-	123,800	33,500	88	183	Retained	Brocks Gap project
"	17	25	Retained	-	20,000	4,500	383	724	Retained	-
"	18	110	Retained	-	95,000	30,000	181	314	Retained	-
"	19	30	Retained	-	23,000	4,200	495	1,048	Eliminated	High cost
"	20	27	Retained	-	12,500	2,400	417	1,076	Retained	-
"	21	65	Retained	-	50,000	18,000	342	521	Eliminated	High cost
"	22	27	Retained	-	22,000	4,500	628	1,270	Retained	Possible flood control
"	23	190	Retained	-	155,000	62,000	143	292	Retained	North River project
"	24	60	Retained	-	45,500	15,000	319	489	Retained	North River Gap project
"	24-A	24	Eliminated	High cost for storage provided	-	-	-	-	-	-
"	24-B	33	Eliminated	High cost for storage provided	-	-	-	-	-	-

TABLE 4 (Continued)

SUMMARY OF PRELIMINARY ANALYSIS OF MAJOR RESERVOIRS
POTOMAC RIVER BASIN

Location			First Review			Second Review					
						Range of Storage		Range of Cost			
Stream	No.[1]	Drainage Area Sq. Mi.	Disposition	Reason for Elimination		Max Ac-Ft	Min Ac-Ft	Min Cost[2]	Max Cost	Disposition	Remarks
Shenandoah River (Continued)	25	395	Eliminated	Railroad relocation & unfavorable right abutment		-	-	-	-	-	-
"	26	173	Retained	-		123,000	40,000	133	180	Retained	-
"	27	125	Eliminated	Storage limitations by Town of Churchville, Va.		-	-	-	-	-	-
"	28	60	Retained	-		44,000	11,000	187	318	Retained	-
"	29	43	Retained	-		35,300	9,000	188	392	Eliminated	Site No. 32 is cheaper
"	30	133	Eliminated	Topographic Limitations & R.R. Relocation		-	-	-	-	-	-
"	31	69	Eliminated	Excessive cost for small storage		-	-	-	-	-	-
"	32	320	Retained	-		220,000	31,700	78	184	Retained	Staunton project
"	33	210	Eliminated	Topographic Limitations & R.R. Relocation		-	-	-	-	-	-
"	34	880	Retained	-		100,500	34,600	167	314	Retained	-
"	35	1185	Eliminated	High cost for limited capacity		-	-	-	-	-	-
"	36	1345	Eliminated	Topographic Limitations & R.R. Relocation		-	-	-	-	-	-
"	37	1403	Eliminated	Site No 38 is more economical		-	-	-	-	-	-
"	38	1423	Retained	-		103,000	24,000	529	1107	Retained	-
"	39	1445	Eliminated	Inundates Massanutten Power Plant		-	-	-	-	-	-
"	40	1480	Retained	-		17,500	-	516	-	Eliminated	High cost for storage
"	41	1510	Eliminated	Geologic & Topographic Limitations		-	-	-	-	-	-
"	41-A	1510	Retained	-		297,000	81,500	132	241	Retained	-
"	41-B	1513	Eliminated	Site No. 42 is more economical		-	-	-	-	-	-
"	42	1515	Retained	-		414,500	101,800	84	134	Retained	-
"	43	820	Eliminated	Topographic Limitations		-	-	-	-	-	-
"	44	1660	Eliminated	Severe Topographic Limitations		-	-	-	-	-	-
"	45	1705	Retained	-		379,000	132,000	114	135	Retained	Karo project
"	46	66	Retained	-		54,000	12,000	189	417	Eliminated	Site No. 35 is cheaper
"	47	93	Eliminated	High cost for small storage		-	-	-	-	-	-
"	48	50	Eliminated	High cost for small storage		-	-	-	-	-	-
"	49	3020	Retained	-			102,000		171	Eliminated	High cost for limited storage
"	50	130	Eliminated	Site No. 52 is more economical		-	-	-	-	-	-
"	51	133	Eliminated	Site No. 52 is more economical		-	-	-	-	-	-
"	52	73	Retained	-		57,000	15,400	178	298	Retained	-
Monocacy River	1	970	Eliminated	Excessive Relocations		-	-	-	-	-	-
"	2	605	Retained	-		330,000	150,000	76	125	Retained	Woodsboro project
"	3	83	Retained	-		52,500	19,000	205	232	Eliminated	High cost for storage
"	4	83	Retained	-		64,000	11,000	134	268	Retained	-
"	5	320	Retained	-		68,000	19,000	184	382	Retained	Six Bridge project
"	6	105	Retained	-		23,000	8,500	386	512	Retained	-
"	7	80	Retained	-		47,200	14,300	311	642	Retained	-
Catoctin Creek Md.	1	89	Retained	-		45,000	19,000	302	526	Retained	-
Catoctin Creek Va.	1	88	Eliminated	Excessive cost for storage		-	-	-	-	-	-
Goose Creek	1	346	Eliminated	Construction initiated by local interests		-	-	-	-	-	-
"	2	266	Eliminated	to develop water supply pre-empts use of		-	-	-	-	-	-
"	3	185	Eliminated	this basin		-	-	-	-	-	-
"	4	95	Eliminated	"		-	-	-	-	-	-
"	5	158	Eliminated	"		-	-	-	-	-	-
"	6	141	Eliminated	"		-	-	-	-	-	-
"	7	25	Eliminated	"		-	-	-	-	-	-
"	8	80	Eliminated	"		-	-	-	-	-	-
"	9	151	Eliminated	"		-	-	-	-	-	-
"	10	45	Eliminated	"		-	-	-	-	-	-
"	11	37	Eliminated	"		-	-	-	-	-	-
"	12	333	Eliminated	"		-	-	-	-	-	-
"	13	32	Eliminated	"		-	-	-	-	-	-
"	14	24	Eliminated	"		-	-	-	-	-	-
Seneca Creek	1	154	Eliminated	High cost of storage		-	-	-	-	-	-
"	2	60	Eliminated	High cost of storage		-	-	-	-	-	-
Difficult Run	1	59	Eliminated	Apparent lack of need		-	-	-	-	-	-
Rock Creek	1	30	Eliminated	High cost for limited storage		-	-	-	-	-	-
Anacostia River	1	32	Eliminated	Excessive cost for storage		-	-	-	-	-	-
"	2	8	Eliminated	Very small drainage area		-	-	-	-	-	-
"	3	16	Eliminated	Very small drainage area		-	-	-	-	-	-
Holmes Run	1	-	Eliminated	The stream is partially developed and there is a lack of need in the downstream area.		-	-	-	-	-	-
Henson Creek	1	20	Eliminated	Small drainage area		-	-	-	-	-	-
Piscataway	1	16	Eliminated	Due to the apparent lack of appreciable		-	-	-	-	-	-
"	2	45	Eliminated	downstream benefits, these sites are		-	-	-	-	-	-
"	3	24	Eliminated	considered uneconomical.		-	-	-	-	-	-
Occoquan Creek	1	-	Eliminated	The high level of existing and planned		-	-	-	-	-	-
"	2	-	Eliminated	development of this basin eliminates		-	-	-	-	-	-
"	3	-	Eliminated	these sites from consideration.		-	-	-	-	-	-
"	4	-	Eliminated	"		-	-	-	-	-	-
"	5	-	Eliminated	"		-	-	-	-	-	-
"	6	-	Eliminated	"		-	-	-	-	-	-
"	7	-	Eliminated	"		-	-	-	-	-	-
"	8	-	Eliminated	"		-	-	-	-	-	-
"	9	-	Eliminated	"		-	-	-	-	-	-
Mattawoman	1	38	Eliminated	Due to the apparent lack of appreciable		-	-	-	-	-	-
"	2	50	Eliminated	downstream benefits, these sites are		-	-	-	-	-	-
"	3	77	Eliminated	considered uneconomical.		-	-	-	-	-	-
Quantico Creek	1	-	Eliminated	Lack of needs		-	-	-	-	-	-
Beaverdam Run	1	-	Eliminated	Apparent lack of need		-	-	-	-	-	-
Zekiah Run	1	31	Eliminated	Due to the apparent lack of appreciable		-	-	-	-	-	-
"	2	62	Eliminated	downstream benefits, these sites are		-	-	-	-	-	-
"	3	12	Eliminated	considered uneconomical.		-	-	-	-	-	-
Gilbert Run	1	21	Eliminated	"		-	-	-	-	-	-
"	2	39	Eliminated	"		-	-	-	-	-	-
Cheptico Creek	1	30	Eliminated	"		-	-	-	-	-	-
St Clement	1	19	Eliminated	"		-	-	-	-	-	-
McIntosh	1	28	Eliminated	"		-	-	-	-	-	-
Potomac River	1	11,457	Retained	-		985,000	425,000	104	130	Retained	Riverbend
"	1-A	11,400	Retained	-		785,000	325,000	116	164	Retained	Seneca
"	2	-	Eliminated	These sites all have limited storage		-	-	-	-	-	-
"	2-A	-	Eliminated	potential in comparison to the size of		-	-	-	-	-	-
"	3	-	Eliminated	structure required. The upper sites also		-	-	-	-	-	-
"	3-A	-	Eliminated	involve extensive relocations		-	-	-	-	-	-
"	4	-	Eliminated	"		-	-	-	-	-	-
"	4-A	-	Eliminated	"		-	-	-	-	-	-
"	5	-	Eliminated	"		-	-	-	-	-	-
"	5-A	-	Eliminated	"		-	-	-	-	-	-
"	6	-	Eliminated	"		-	-	-	-	-	-
"	7	-	Eliminated	"		-	-	-	-	-	-

1/ Locations are shown on Figure 25

2/ Total first cost per acre-foot of conservation storage

Data on the 59 sites remaining were developed in greater detail. Preliminary designs and cost estimates were made for at least three sizes of development. Low flow augmentation yield-storage relationships, flood reduction-storage relationships, preliminary evaluation of potential uses of the water resource goods and services provided, and preliminary analysis of non-monetary beneficial and detrimental effects of each site were developed in this phase. Table 5 (page 389) shows the planning data.

4. Selection and Screening of Headwater Reservoirs. Headwater reservoir studies were made by the U.S. Department of Agriculture. Following procedures similar to those used in the studies of major reservoirs, more than 2500 headwater reservoir sites were located on topographic maps. These were selected on the basis of a minimum storage capacity equivalent to 4 inches of runoff, limitation of height of dam to around 100 feet, considering development within the pool area and the relocations required. Drainage areas for these reservoirs range from 1 to about 25 square miles. About 1700 of those selected in the map studies were subsequently eliminated from further consideration, primarily because of unfavorable topography. The 800 remaining sites were given a more detailed investigation, which included preliminary designs and cost estimates, storage-cost relationships, low flow augmentation yields, potential flood flow retardation effects and an evaluation of potential uses of the water resource goods and services which could be provided.

5. Development of Alternative Plans. Alternative plans were developed from the data accumulated. Each plan was selected to suit the purposes or areas to be served. This process of alternative plan establishment was accomplished mainly by a joint work group consisting of representatives of the Federal agencies directly concerned in this study.

From the gross needs or demands, for all needs centers, that portion which could be satisfied under existing conditions was subtracted, leaving the net requirements which must be satisfied by development. Starting in the uppermost reaches of the Basin, projects were selected from the planning data prepared by the Corps of Engineers and the Department of Agriculture, to serve those needs centers having net requirements. The procedure was based on the assumption that any quantity of flow added to a stream will continue to flow down the river substantially undiminished and will serve requirements at any point it passes. It was further based on the fact that the requirements were computed to maintain water quality standards permitting reasonably unrestricted use and reuse.

A specific project based on the data available, which would fulfill the requirements of the most upstream point of need most economically, was selected as the first step in project selection. The effects of this project were analyzed on downstream until a point of unsatisfied need was reached. Then the situation was re-evaluated to determine the most economical satisfaction for the new requirement. This resulted in a change in the size of the initially selected project, a project replacing the originally selected one but capable of fulfilling the total

TABLE 5

SUMMARY OF PLANNING DATA - MAJOR RESERVOIRS

Location		Minimum Flow	Minimum Development Studied		Optimum Development Studied		Maximum Development Studied		Potential User		Remarks
Stream	No.	cfs	cfs	Cost 1/	cfs	Cost 1/	cfs	Cost 1/	Low Flow	Flood Control	
Patterson Creek											
"	1	14	100	5600	194	3790	194	3790	Washington, D.C.	Patterson Cr., W.Va.	
"	2	2	40	6000	71	5350	71	5350	"	Ft. Ashby & Patterson Creek, W.Va.	
"	4	3	75	7150	123	5060	123	5060	"	" "	
"	6	6	80	2600	163	2130	163	2130	"	" "	Headsville
South Branch Potomac River	1	3	80	3910	120	3250	171	4330	Franklin, W. Va.	Franklin, W. Va.	
"	4	5	175	2510	175	2510	300	3420	Washington, D.C.	Petersburg & Moorefield, W. Va.	
"	5	5	74	3680	210	2850	261	2880	"	"	
"	7	43	233	1610	289	1580	490	1770	"	"	Royal Glen
"	10-A	50	280	2400	680	1880	1093	1930	"	Main Stem Potomac R.	Springfield
"	11	8	96	2420	96	2420	162	2760	"	Moorefield, W Va.	
Town Creek	4	3	50	4640	142	2520	142	2520	Washington, D.C.	-	Town Creek
Little Cacapon	1	2	25	4300	95	2280	95	2280	Washington, D.C.	-	Little Cacapon
Sideling Hill	1	2	25	6250	94	3580	94	3580	Washington, D.C.	-	Sideling Hill
Cacapon River											
" "	1	35	222	1880	300	1870	462	2180	Washington, D.C.	Great Cacapon, W.Va. & Main Stem Potomac R.	Edes Fort
" "	2	35	117	2460	217	2070	427	2230	"	" " "	
" "	3	25	106	5780	282	2990	282	2990	"	" " "	
" "	6-A	2	27	9800	114	3470	114	3470	"	-	
Tonoloway Creek	1	1	25	4320	105	2630	105	2630	Washington, D.C.	-	Tonoloway Creek
Sleepy Creek	1	3	58	4680	109	3300	127	3500	Washington, D.C.	-	
Licking Creek	1	4	54	3920	114	2700	147	2750	Washington, D.C.	-	Licking Creek
Back Creek	3	18	66	4430	220	2360	220	2360	Washington, D.C.	-	North Mountain
Conococheague	1	30	232	3340	382	2580	443	2590	Washington, D.C.	Williamsport, Md.	
"	2	2	25	9600	67	5150	67	5150	Greencastle & Mercersburg, Pa.	Lower Conococheague Valleys	West Branch
"	5	1	31	11920	56	7200	56	7200	Greencastle, Pa.	Conococheague Valley	Back Creek
"	6	3	-	-	59	6700	-	-	Chambersburg & Greencastle, Pa.	" "	Chambersburg
Opequon Creek	2	6	100	3800	190	2790	241	3190	Washington, D.C.	-	
"	4	2	51	6200	98	3820	98	3820	Winchester, Va. & Martinsburg, W.Va.	Lower Opequon Valley	Winchester
"	5	1	19	7790	30	6800	35	7370	"	" " "	
Shenandoah River	1	59	1002	1540	1002	1540	1816	1920	Washington, D.C.	Main Stem	
"	2	59	253	2246	979	1348	1192	1390	"	Millville, Main Stem Potomac	
"	4	59	598	1664	1059	1290	1059	1290	"	" "	
"	5	9	287	3480	418	3240	418	3240	"	Riverton & Front Royal	
"	6	1	23	7650	36	6460	51	6590	Front Royal, Va.	-	
"	8	6	119	2050	196	1670	296	1940	Strasburg, Va.	-	
"	12	1	22	10920	40	9400	49	9440	Strasburg, Va.	-	
"	16	1	63	5330	147	3930	147	3930	Broadway & Timberville, Va.	North Fork Shenandoah Valley	Brocks Gap
"	17	1	7	18900	16	16500	16	16500	"	" " "	
"	18	2	33	9090	73	7040	73	7040	"	" " "	
"	20	1	8	15500	12	13920	18	15450	"	" " "	
"	22	1	7	31410	17	29550	17	29550	Harrisonburg & Bridgewater, Va.	North River Valley	
"	23	9	51	8630	96	7310	104	7750	"	" " "	
"	24	1	20	13600	35	13000	40	13000	"	" " "	
"	26	3	84	2860	84	2860	135	3720	South Fork Valley	South Fork Valley	
"	28	1	27	4800	40	4470	47	5110	" " "	" " "	
"	32	16	99	2270	99	2270	240	3150	Staunton, Va.	" " "	Staunton
"	34	42	306	2200	-	-	-	-	South Fork Valley	" " "	
"	38	40	245	6070	345	5100	473	5400	Front Royal, Va. & Washington, D.C.	-	
"	41-A	46	381	2066	756	2061	756	2061	"	-	
"	42	46	424	1287	560	1200	927	1495	"	-	
"	45	59	726	1740	726	1740	1101	1810	"	-	Karo
"	52	1	20	7500	27	7410	49	7550	"	-	
Catoctin Creek, Md.	1	1	38	7800	38	7800	61	8250	Washington, D.C.	-	
Monocacy River	2	25	199	2700	489	2260	489	2260	Frederick, Md.	Monocacy Valley	
"	4	1	25	3600	31	3360	69	3540	"	" "	
"	5	1	-	-	208	2950	-	-	"	" "	
"	6	1	30	5700	30	5700	51	7000	"	" "	Six Bridge
"	7	1	25	12200	68	8920	68	8920	"	Upper Monocacy Valley	
Potomac River	1	782	1748	1076	2578	1000	3243	1072	Washington, D.C.	Washington, D.C.	Seneca
	1-A	782	2163	1161	2878	1052	3588	1150	"	"	Riverbend

1/ Average annual cost per cfs increase in dependable minimum flow provided.

requirements to that point, or an additional project. In this manner, the process was repeated moving from one point of need to the next one following the flow of the stream. At each step in the process, all the purposes were analyzed so as to add those that could be at least incrementally justified until the last increment added benefits equal to the cost of its inclusion. This procedure is really a rough analyses of the systems response surface and a maximization of systems net benefits by a procedure akin to the method of steepest ascent. Using different assumptions and planning constraints, several different plans were developed using this procedure.

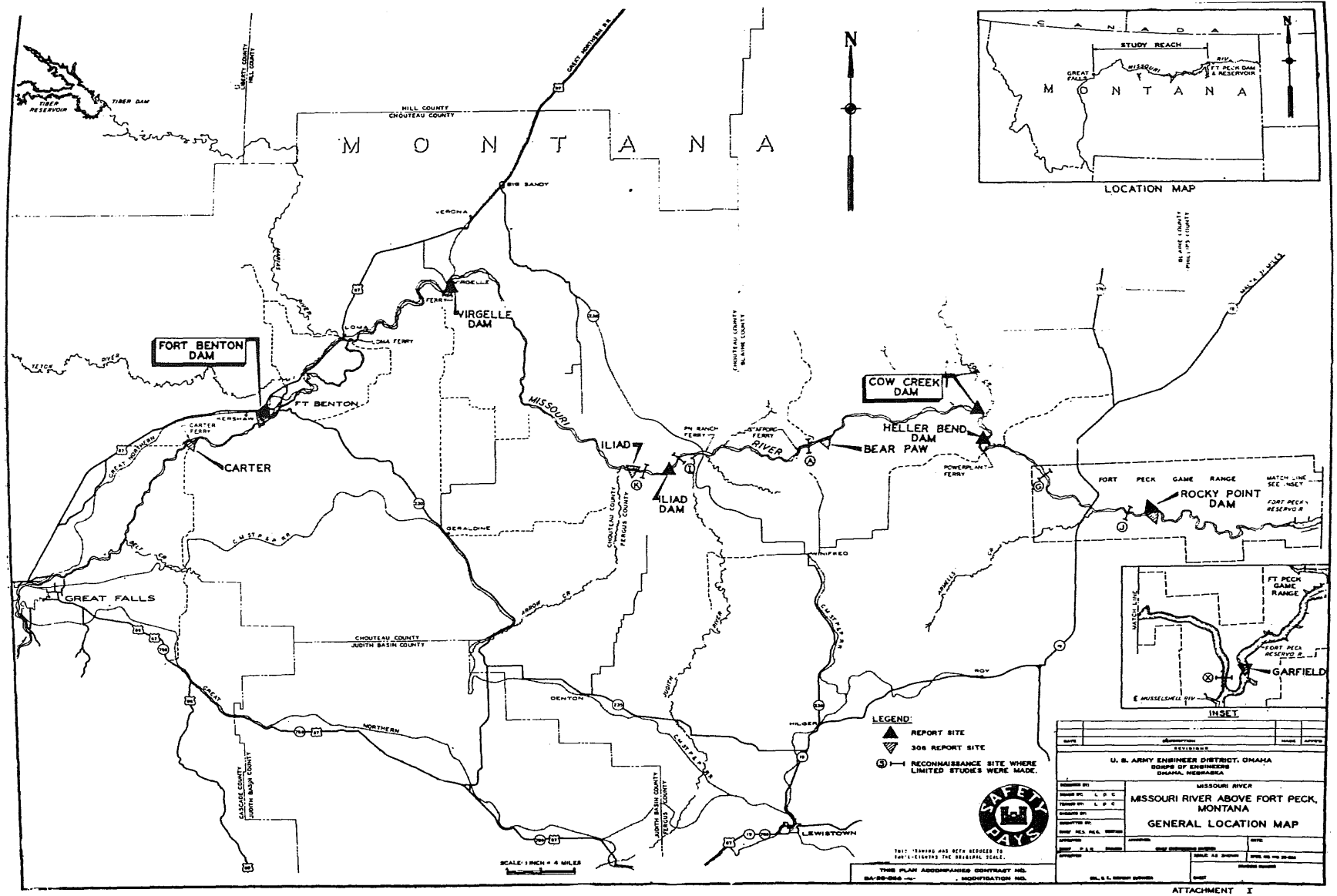
Upper Missouri.

This study was made as a joint investigation by the Corps of Engineers and the Department of the Interior. It is used as an example of the "functional approach" since from a practical standpoint power and recreation became the two principal functions. This study is also of interest in that as of this date the joint report by the two field offices presents eleven plans with a general recommendation but a decision as to THE PLAN remains to be made at the policy level.

1. Location and General Description. The reach of the Missouri River studied by the Corps and Interior is located in North Central Montana, with practical limits from the head of the Fort Peck Reservoir to Morony Dam, a power installation of the Montana Power Company (See Attachment 1, Page 391). The drainage area of the Missouri River above Morony Dam is about 23,250 square miles, and the drainage area of the Missouri River at the head of Fort Peck Reservoir is about 41,750 square miles. The length of the river from Morony Dam to Fort Peck Reservoir is 200 miles. In this reach the maximum gross head available for development is about 550 feet and the average annual stream flow as reduced by estimated future depletions is about 5.8 million acre-feet.

2. Objectives of Program Formulation. In formulation of a plan of improvement the basic objective was to provide for the best use, or combination of uses, of water and related land resources to meet all foreseeable short and long term needs. One phase of the joint investigation, that was conducted by the Omaha Engineer District and Region 6 of the Bureau of Reclamation, was aimed primarily at formulating multiple-purpose reservoir plans, but consideration was given to other types of improvements to meet specific objectives, in some instances not entirely compatible with reservoir construction, developed by others.

Potential reservoirs were to provide for the maximum practicable development of power head available in the study reach; replacement of part of the flood control storage in existing Missouri River main stem reservoirs in order to increase net benefits through operation of the latter at higher pool elevations; inclusion of an enhancement program for fish and wildlife in order to optimize fish and wildlife values to the extent they are practicable and economically justified; inclusion of



ATTACHMENT I

recreational facilities to the maximum extent practicable and economically justified in order to meet the growing demands for outdoor recreation; and preservation of major portions of the area, insofar as practicable with reservoirs, to provide recreational enjoyment associated therewith. Establishment of these objectives simplified the screening process since development of head became a paramount consideration and our Steps (1) - (3) inclusive, were combined in one -- to secure the various combinations of head at available sites. This is the functional approach in its simplest form in that by a judgment decision a significant reduction was made in the number of combinations to be analyzed. In this way the basic framework was obtained upon which additions or modifications could be made to consider subordinate functions.

3. Proposals by Other Agencies

a. A potential national park development aimed at preserving the wilderness character of the river and adjacent land areas was proposed. This proposal, in its entirety, would conflict with reservoir development. However, certain parts of a wilderness preservation objective could be incorporated with reservoir development.

b. A potential public land management program was proposed to provide for consolidation of public lands, to provide access and the facilities for optimum public use of these lands, to provide suitable soil and water conservation facilities, and to adopt management practices which would result in optimum coordinated use of these lands in the interest of both livestock and wildlife production.

c. A potential fish and wildlife development was proposed to permit optimum realization of the tremendous potential to provide for future wildlife needs, to temper the impact of major additional wildlife development on established livestock use, and to incorporate major wetlands development to help counteract loss of waterfowl production habitat that has been occurring extensively in the northern states.

4. Dams and Reservoirs. After preliminary consideration of an appreciable number of potential dams and reservoirs, those at six sites, including dams and reservoirs of more than one size at some sites, were selected for more detailed study. These are identified, and limited pertinent power data concerning them, are shown on Table 6, page 393. Each of these systems would be obtained by our Step (4).

5. Alternative Improvement Programs. The alternative improvement programs developed for comparison as a basis for selection of the best improvement program for the study reach were eleven in number and are designated as plans 1 to 11, inclusive. They consist essentially of nine combinations of reservoirs together with one or more of the "Proposals of Other Agencies" and two plans that were basically a non-reservoir proposal or included only one reservoir. By their very

JOINT ARMY — INTERIOR STUDY
MISSOURI RIVER
FORT PECK — FORT BENTON, MONTANA
PHYSICAL FEATURES AND ANALYSIS OF ALTERNATIVE PLANS

PLAN	PLAN COMPONENT	APPROX. DAM HEIGHT	RESERVOIR STORAGE CAPACITY	SEASONAL FLOOD CONTROL STORAGE	POWER MAXIMUM HEAD	POWER INSTALLED CAPACITY	COST PROJECT[1]	ANNUAL COST	ANNUAL BENEFITS	EXCESS BENEFITS	BENEFIT COST RATIO
		(FEET)	(ACRE-FEET)	(ACRE-FEET)	(FEET)	(KW)		(IN THOUSANDS OF DOLLARS)			
1.	Fort Benton	192	765,000	100,000	117	300,000	114,375	4,362	7,825	3,463	1.8
	Iliad	214	2,450,000	200,000	196	370,000	144,454	5,426	10,000	4,574	1.8
	High Rocky Point	225	2,500,000	200,000	172	340,000	140,000	5,544	8,744	3,200	1.6
	Recreation						8,888	457	900	443	2.0
	Fish and Wildlife[2]						8,005	601	1,570	969	2.6
	Agricultural Land Mgmt.						3,820	185	343	158	1.9
	Plan Totals	——	5,715,000	500,000	545	1,010,000	419,542	16,575	29,382	12,807	1.8
2.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	Heller Bend	375	9,650,000	400,000	333	740,000	237,000	9,216	18,799	9,583	2.0
	Low Rocky Pt.	53	130,000	0	37	73,000	68,400	2,609	1,965	644	0.8
	Recreation						9,678	498	900	402	1.8
	Fish & Wildlife						8.005	601	1,570	969	2.6
	Agricultural Land Mgmt.						3,820	185	343	158	1.9
	Plan Totals	——	10,545,000	500,000	547	1,113,000	441,278	17,471	31,402	13,931	1.8
3.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	Heller Bend	375	9,650,000	400,000	333	740,000	237,000	9,216	18,799	9,583	2.0
	Recreation						8,418	432	810	378	1.9
	Fish & Wildlife[2]						18,828	1,148	1,837	689	1.6
	Agricultural Land Mgmt.[3]						3,820	185	343	158	1.9
	Plan Totals	——	10,415,000	500,000	510	1,040,000	382,441	15,343	29,614	14,271	1.9
4.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	High Cow Creek	365	8,750,000	400,000	323	720,000	217,200	8,501	18,211	9,710	2.1
	Recreation						8,418	432	810	378	1.9
	Fish & Wildlife[2]						18,828	1,148	1,845	697	1.6
	Agricultural Lahd Mgmt.[3]						3,820	185	343	158	1.9
	Plan Totals	——	9,515,000	500,000	500	1,020,000	362,641	14,628	29,034	14,406	2.0
5.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	High Cow Creek	365	8,750,000	400,000	323	720,000	217,200	8,501	18,211	9,710	2.1
	Low Rocky Pt.	63	200,000	0	47	94,000	73,100	2,860	2,520	340	0.9
	Recreation						9,678	498	900	402	1.8
	Fish & Wildlife[2]						8,005	601	1,570	969	2.6
	Agricultural Land Mgmt.[3]						3,820	185	343	158	1.9
	Plan Totals	——	9,715,000	500,000	547	1,114,000	426,178	17,007	31,369	14,362	1.8
6.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	Recreation						9,382	674	757	83	1.1
	Fish & Wildlife[2]						18,415	1.135	1,847	712	1.6
	Agricultural Land Mgmt.						3,820	185	343	158	1.9
	Plan Totals	——	765,000	100,000	177	300,000	145,992	6,356	10,772	4,416	1.7
7.	Recreation						8,957	610	518	92	0.8
	Fish & Wildlife[2]						18,258	1.116	1,839	723	1.6
	Agricultural Land Mgmt.[3]						3,820	185	343	158	1.9
	Plan Totals						31,035	1.911	2,700	789	1.4
8.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	Virgelle	150	940,000	100,000	103	180,000	125,600	4,456	4,779	323	1.1
	Recreation						8,539	600	600	0	1.0
	Fish & Wildlife[2]						18,570	1.130	1,859	729	1.6
	Agricultural Land Mgmt.[3]						3,820	185	343	158	1.9
	Plan Totals	——	1,705,000	200,000	280	480,000	270,904	10,733	15,406	4,673	1.4
9.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	Iliad	214	2,450,000	200,000	196	370,000	144,454	5,426	10,000	4,574	1.8
	Low Cow Creek	180	500,000	0	118	225,000	100,500	3,846	6,103	2,257	1.6
	Recreation						8,418	432	750	318	1.7
	Fish & Wildlife						18,970	1,152	1,845	693	1.6
	Agricultural Land Mgmt.						3,820	185	343	158	1.9
	Plan Totals	——	3,715,000	300,000	491	895,000	390,537	15,403	26,866	11,463	1.7
10.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	Low Cow Creek	180	500,000	0	118	225,000	100,500	3,846	6,103	2,257	1.6
	Recreation						7,444	434	450	16	1.0
	Fish & Wildlife[2]						18,770	1,146	1,845	699	1.6
	Agricultural Land Mgmt.[3]						3,820	185	343	158	1.9
	Plan Totals	——	1,265,000	100,000	295	525,000	244,909	9,973	16,566	6,593	1.7
11.	Fort Benton	192	765,000	100,000	177	300,000	114,375	4,362	7,825	3,463	1.8
	Virgelle	150	940,000	100,000	103	180,000	125,600	4,456	4,779	323	1.1
	Low Cow Creek	180	500,000	0	118	225,000	100,500	3,846	6,103	2,257	1.6
	Recreation						8,046	489	450	39	0.9
	Fish & Wildlife[2]						18,628	1,142	1,832	690	1.6
	Agricultural Land Mgmt.[3]						3,820	185	343	158	1.9
	Plan Totals	——	2,205,000	200,000	398	705,000	370,969	14,480	21,332	6,852	1.5

[1] Includes construction, engineering, and overhead

[2] Benefit estimates represent values calculated in both Bureau of Land Mangement and Fish and Wildlife plans, adjusted to avoid duplication

[3] The benefit estimate is entirely from the Bureau of Land Management plan

nature some of these plans would not be compatible with the land management, fish and wildlife, or wilderness waterway proposals. The approach used may be considered comparable to our Step (5). The plans are described briefly in the following paragraphs. A comparison is given in Table 7, page 396 .

Plan 1. Plan 1 includes Fort Benton, Illiad, and High Rocky Point dams and reservoirs, and the public land management program. The three reservoir systems would develop most of the available power head.

Plan 2. Plan 2 includes Fort Benton, Heller Bend, and Low Rocky Point dams and reservoirs, and the public land management program. This three-reservoir system would also develop most of the available power head, but with the maximum head development in a single project, Heller Bend.

Plan 3. Plan 3 includes Fort Benton and Heller Bend dams and reservoirs; the public land management program; and a modification of the fish and wildlife program, excluding only that part of the proposed Missouri Breaks Wildlife Area above the Heller Bend damsite. The two-reservoir system would accomplish development of the bulk of the power head available and would permit installation of the bulk of the fish and wildlife enhancement program.

Plan 4. Plan 4 includes Fort Benton and High Cow Creek dams and reservoirs; the public land management program, and most of the fish and wildlife program. This two-reservoir system also would accomplish development of the bulk of the power head and would permit installation of the fish and wildlife program with only very minor modification.

Plan 5. Plan 5 includes Fort Benton, High Cow Creek, and Low Rocky Point dams and reservoirs; and the public land management program. The three-reservoir system would develop most of the available power head.

Plan 6. Plan 6 includes Fort Benton dam and reservoir; the wilderness waterway; the public land management program, and the fish and wildlife program. Plan 6 would permit development of only a comparatively small part of the power head, the maximum compatible with the total wilderness waterway. Comparison of Plan 6 with Plans 4, 5, and 9 permits judgment of the relative merits of development below Fort Benton primarily for power as opposed to development to provide a wilderness waterway with only such power development as is fully compatible with the wilderness waterway proposal.

Plan 7. Plan 7 includes the wilderness waterway; the public land management program; and the fish and wildlife program. Comparison of Plan 7 with Plans 4, 5 and 9 permits judgment of the relative merits of development of the study reach primarily for power and development to provide a wilderness waterway without power development.

Plan 8. Plan 8 includes Fort Benton and Virgelle dams and reservoirs; a modified wilderness waterway including only that part of the overall wilderness waterway proposal that lies below the Virgelle damsite; the public land management program, and the fish and wildlife program. Plan 8 represents an adjustment between development primarily for power and preservation as a wilderness waterway.

Plan 9. Plan 9 includes Fort Benton, Illiad, and Low Cow Creek dams and reservoirs; the public land management program; and most of the fish and wildlife program.

Plan 10. Plan 10 includes Fort Benton and Low Cow Creek dams and reservoirs; the public land management program, and most of the fish and wildlife program.

Plan 11. Plan 11 includes Fort Benton, Virgelle, and Low Cow Creek dams and reservoirs; the public land management program; and most of the fish and wildlife program.

PLAN COMPARISONS

Plan	Flood Control Replacement Storage in Acre Feet	Power Head In Feet	Power Installed Capacity Kilowatts	Preservation Miles	Recreational Use Visitor Days
1	500,000	545	1,010,000	20	600,000
2	500,000	547	1,113,000	20	600,000
3	500,000	510	1,040,000	46	540,000
4	500,000	500	1,020,000	51	540,000
5	500,000	547	1,114,000	20	600,000
6	100,000	177	300,000	180	505,000
7	0	0	0	180	345,000
8	200,000	280	480,000	130	400,000
9	300,000	491	895,000	52	500,000
10	100,000	295	525,000	135	300,000
11	200,000	398	705,000	85	300,000

6. Evaluation of Plans. In order to provide a basis for selecting the plan which would provide for optimizing development of all resources in the study area, an economic analysis, based on tangible monetary evaluations, was made. Table 6, page 393, presents a comparison of total investments required for each plan and annual charges, benefits, benefit-cost ratios, and excesses of benefits over costs. Based on tangible effects only, Plans 3, 4 and 5 all appear to be capable of developing the resources of the area by the most efficient method. The slight differences in the excess of benefits over costs between each of these plans are well within error limits of the estimates. However, when intangibles are considered, a reasoned choice between the plans can be made. The Heller Bend dam and reservoir (Plan 3) and the Rocky Point dam and reservoir (Plan 5) would not permit full development of fish and wildlife opportunities and would also destroy unique habitat in the reach of river between Fort Peck reservoir and the mouth of Cow Creek. The losses in both existing values and future opportunities cannot be measured entirely in terms of costs and monetary benefits or losses. When these intangibles are considered, Plan 4 may be considered to be the most desirable development in the study reach.

Plan 4, however, is not entirely compatible with the wilderness preservation plan. Inspection of Table 6 reveals that the excess of benefits over costs for Plan 4 is several times greater than for Plan 7, or alternates thereto incorporating some preservation of the river. However, it is recognized that significant intangible values are associated with the wilderness development. Adoption of Plan 4 would not eliminate entirely the possibility of preserving a part of the study area in its wilderness state. Of the original 180 miles of river and valley included in the wilderness proposal, 51 miles would not be inundated and could be preserved in its natural state. The existence of reservoir areas would also make possible access to natural scenic areas, by boat as well as roads constructed in conjunction with reservoirs. From an economic standpoint that weighed both tangibles and intangibles, as indicated above, Plan 4 would appear to be the most desirable development for this reach. It should be noted that the values cited above were obtained from advance copies of the agency reports and may be revised prior to publication of the final report.

7. Selection of Plan. As of this date the ultimate decision is yet to be made and the final judgment may be one of policy. The Information Bulletin presenting the eleven plans to the public stresses this information under "Guides to Plan Selection."

> "The preceding table (Table 6, page 393) presents the data necessary for comparing the costs, the evaluated tangible benefits, and the excess of tangible benefits over costs for each of the eleven alternative plans of improvement considered. In judging the relative desirability of the several plans, however, intangible benefits also should be considered; and an

effort has been made in the preceding section to describe the intangible benefits involved.

"No effort is made herein to guide public judgment of intangibles or of the weight that should be given to intangibles in contrast to evaluated tangible benefits. Each person comparing the relative merits of the several plans must make that judgment for himself."

DISCUSSION

In the beginning of this paper we have noted the outline of the ideal solution for basin planning - analyze all possibilities and all combinations. The theoretical apostles of econometrics would in this solution remove the planner from the scene. All decisions would be final, springing from the logical interrelation of all factors, neatly quantified.

Screening is the compromise with reality and regardless of the orderly quasi scientific points we have tried to present, it is an art, practiced by humans using knowledge, experience and imagination. It is important to realize that the screening decisions are final. A project eliminated has no chance of being considered in the final decision making. Therefore, it is probably more important to stress the general guide lines of the screening process then to weigh the various methods. The general guide lines of all screening can be summarized as follows:

1. To avoid unnecessary effort it is essential to apply:

    a. Judgment in sizing units and estimating range of benefits.

    b. Experience in establishing operating plan.

This places the further requirements that the screening process be accomplished only by the most experienced planning personnel available.

2. We should avoid undue injection of bias for, or against, any particular project or project purpose that tends to weight the basin plan to favor that project or purpose. This can creep in whenever decisions are made on a judgment basis if such bias is present in the mind of the planner.

3. Regardless of the method utilized -- we should attempt to minimize the effect of restrains such as:

a. Water rights. *
b. Political considerations.
c. Conflict between principal purposes.

The matter of constraints is of great importance. Planning completely free of constraints would be unrealistic and could well lead to conclusions which are foreign to the basic institutions of the land and time in which we plan. Too many constraints will fetter the results to prejudged answers. Above all we should not lean upon constraints as a crutch to simplify the problem.

What constraints are used should be used with full knowledge of their effects on the final product. There is for instance, a difference - if it can be called such - between just comprehensive planning and plan formulation for authorization. When we are working toward the latter objective, we must modify our screening procedure to reflect essential political, legal, and sociological restraints. With the increasing emphasis that is being given to comprehensive basin planning, there are many who believe (where our planning resources permit) that the initial considerations be directed toward formulating an optimum plan without regard to restraints even though we know from a practical standpoint we subsequently may have to modify this plan for authorization purposes. This would chart the ideal plan. Also there is always the possibility -- if not hope -- that the importance of the restraints, or the need for their application, may diminish and permit our plan for authorization to be more compatible with the ideal comprehensive plan meeting long term needs. From a practical standpoint, it generally develops that some form of restraint is introduced into the screening process.

The general procedure outlined for some methods -- such as the "order of merit" -- does not ensure that one of our fundamental formulation maxims has been observed. It is entirely possible that as we reach down to include projects having a lower order of merit we may add elements that are not economically justified and that would not meet the "last-added" test, although steps may have been taken to optimize the system. It does not appear practical to resort to additional studies for this one purpose except for tests of subgroups. One possibility in accordance with the screening principle would be to apply the test to a few projects selected at random. Our desired end product is to obtain a choice of plans and alternatives that we may turn over to the policy makers for the final decision and to provide them with sufficient information upon which to base their choice.

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* In one midwestern basin it might be possible to supply all needs but only if existing water rights specifying quantities were negated. A proposal is being studied that would abolish all existing water rights, and replace them by a guarantee that the system would provide all water needed (all that can be used).

You will note that in the illustrative applications there were some departures from the general principles. This may be reflective of the varying importance different planners gave to judgment values.

The screening process as used in the Potomac Basin Studies varied from the ideal use of a comprehensive basin plan by the early introduction of some major restraints. The requirement of obtaining a plan that could be recommended for authorization, and the large value placed on the intangibles of historic and scenic significance by a large portion of the area representation made this necessary. The long history of previous studies of this river and the legislative history of the authorization and funding for the just completed study gave ample evidence as to the firmness of the constraints on power production and the need to test various constraints on the use of major structures on the main stem, the lower Shenandoah and the lower South Branch. A failure to accept these restraints might have produced plans that had no chance of acceptance. It might be stated here that a good plan must be not only maximixed from the economic viewpoint but must have at least some chance of public acceptance.

In many instances it may be possible (where relatively few units are involved) or essential (due to limitation of planning funds) to utilize short-cuts. These are limited only by the ingenuity of the planner. Whatever the device that is utilized, the results will be no better than the basic data. Even when we use the most sophisticated of computers, if we "put garbage in, we will get garbage out."

CONCLUSIONS

Screening of alternatives is an essential part of basin planning.

Any approach involving less than full analysis carries some risk of an erroneous appraisal.

The uncertainties present in evaluating and projecting requirements, costs and benefits, and the errors these uncertainties could introduce greatly exceed this risk. Therefore, we seldom can justify the added detail.

Each basin requires an approach having some basic differences but it is important that a logical pattern be utilized that gives comparable treatment to all aspects.

The planner must keep abreast with all new developments in the field of his art and of the sciences that support it.

Future improvements in computers and the techniques of their use may make possible more sophisticated procedures that will lessen the need for extensive screening or provide more rapid means of supplementing the present techniques.

SELECTION OF THE OPTIMUM PLAN

by
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1. INTRODUCTION: Project formulation procedures for defining the optimum plan for development of the water resources of a basin, within the physical and economic environs of the region, involves the following three broad phases of planning studies.

a. The assessment of present and future water control problems in terms of the nature and dimensions of the needs for the various goods and services of water resource development;

b. The inventory and appraisal of the practical alternative measures and combinations of measures which reasonably might be used to solve the water control problems; and

c. Successive evaluations of the benefits and costs of providing the needed goods and services by all practical means to arrive at a plan of development which will provide maximum net returns while meeting, with the minimum investment in funds and developable measures, the present and anticipated needs for the multiplicity of products associated with water control.

2. From beginning to end, project formulation is largely a matter of measuring, weighing and comparing alternatives to determine their relative efficiency in doing the desired water resource improvement job. For example, where studies establish a need for additional water supply all reasonable measures are considered. In a typical case these might include expansion of existing groundwater or surface water supplies, main-stem or tributary reservoirs, barriers to prevent salinity encroachment, and so on. The benefits and costs and other impacts of each potential are appraised by consistent standards and then compared. Requirements for other purposes are analyzed on a similar basis. By the process of combination, comparison, and elimination the most promising solutions are selected and tested to determine the optimum plan of development. This latter plan is finally tested to determine if it is fully justified economically.

3. PRINCIPLES OF PROJECT FORMULATION: The broad objective of project formulation is to satisfy the specific needs of the area in a manner that will maximize net economic gains and human satisfactions from the use of economic resources in a project. Stated briefly, a project is considered to be properly formulated and economically justified when:

a. Project benefits exceed project costs;

b. Each separable segment or purpose provides benefits at least equal to its costs;

c. The scale of development is such as to provide the maximum net benefits; and,

d. There is no more economical means, evaluated on a comparable basis, of accomplishing the same purpose or purposes which would be precluded from development if the plan were undertaken. This limitation refers only to those alternative possibilities that would be physically displaced or economically precluded from development if the project is undertaken.

4. Net benefits are maximized when the scope of development is extended to the point where the benefits added by the last increment of scale (i.e., an additional unit of reservoir capacity, channel dimension, or length of navigable channel; an individual purpose in a multiple purpose project or plan; or a unit in a comprehensive plan) are equal to the cost of adding that increment of scale. This is illustrated graphically on the accompanying Plate 1.* The increments of scale to be considered in this way are the smallest increments for which there is a practical choice of omission from the plan.

5. Reports or plans should indicate the scale of development that would result from application of the foregoing criteria considering tangible benefits and project economic costs expressed in comparable terms. This will provide a baseline from which the effects of considering intangibles can be judged. Reports and plans also should indicate the extent to which departures from that scale of development, or baseline, are proposed in order to take into account intangibles or other considerations warranting a modification in scale not reflected in the tangible benefits and project economic costs. For example, a higher degree of flood protection, particularly in urban areas, than is feasible on the basis of tangible benefits alone may be justified in consideration of the threat to lives, health and general security posed by larger floods. Also, when long-range water needs are foreseeable only in general terms and where alternate means of meeting the needs are not available and inclusion of additional capacity initially can be accomplished at a significant savings over subsequent enlargement, such considerations may justify the additional cost required. Similarly, long-range power needs, in the light of generally expected economic growth of an area, may justify measures initially to insure later availability of the full power potential.

6. DESIGN AND EVALUATION. A relatively large number of potential projects and improvement measures need to be considered, usually, in arriving at a development program for a basin. The task of analyzing these many improvement potentials can be simplified by varying the extent of basic data assembly and the scope of studies with the complexity of the project and the stage of project investigation. These may be varied progressively from minimum details in the earliest appraisals to the greatest practical level of detail that may be required in the final stages of the studies. In the early stages of the planning studies adequate data on the physical and geographic dimension of the projects usually are available from prior studies, maps and other sources. At this phase of the studies cost estimates of usable quality may be based on preliminary layouts and simplified or reconnaissance type of estimating procedures. As the planning proceeds, step by step, basic data from field

* Plate 1 is page 403.

APPLICATION OF ECONOMIC EFFICIENCY CRITERION IN SELECTION OF DEVELOPMENT FOR SINGLE IMPROVEMENT MEASURE

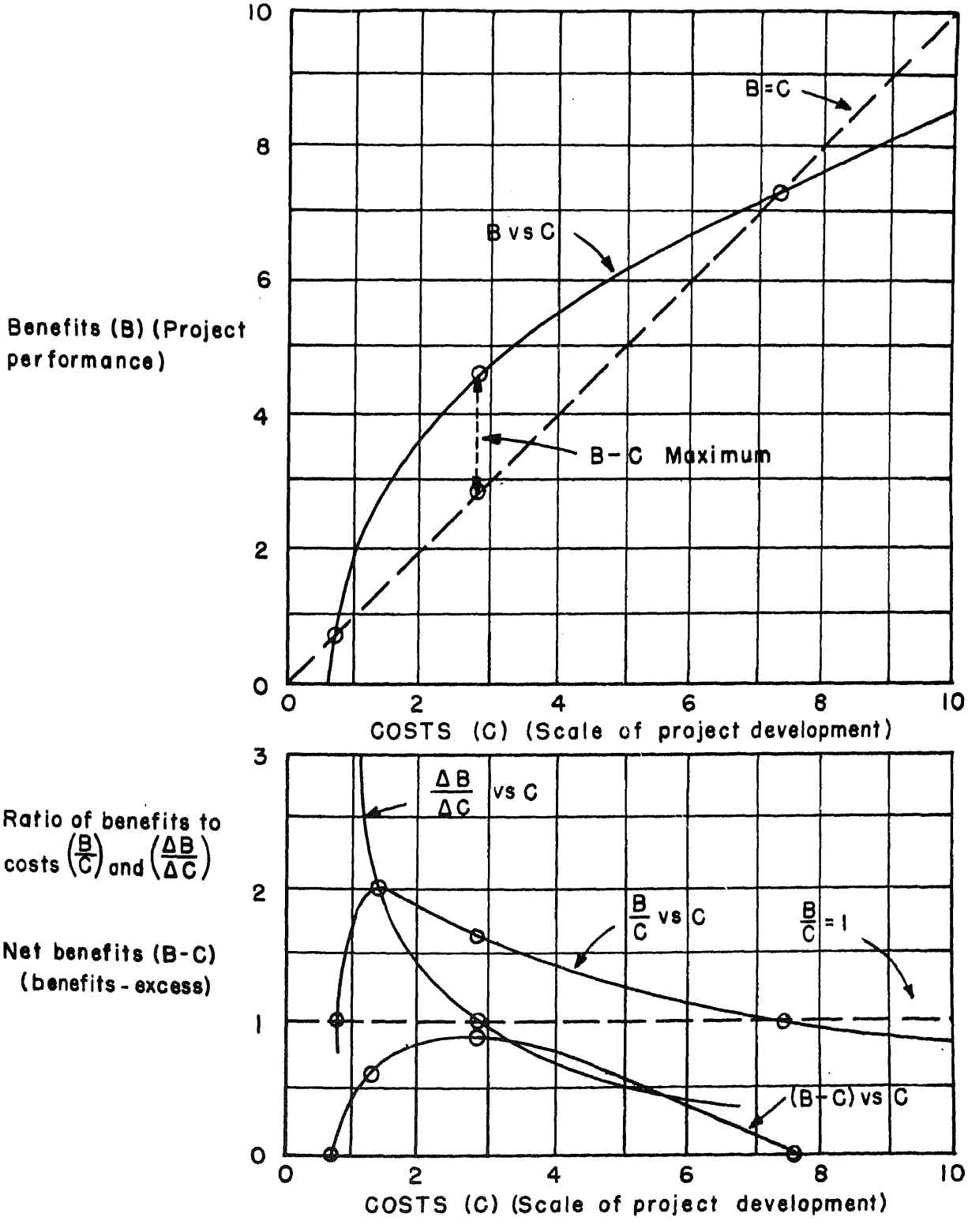


Plate 1

surveys, subsurface investigations, construction materials surveys, and real estate appraisals in the field can be added progressively; project layouts and structural design can be revised and firmed up as added field data and project planning studies indicate; and cost estimates can be refined progressively with regard to quantities and firmness of unit prices.

7. Similar progressive appraisals can be made for the extent and value of the goods and services to be produced by the projects. Sources of data in these instances should be the cooperating agencies in whose field of primary interests the evaluations would normally fall. However, in the event these data are not available from such sources and are needed to permit reasonable progress in the planning studies, the data should be produced by the office doing the project formulation studies, or obtained from other sources, and submitted to the pertinent cooperating agency for comment and/or possible reappraisal.

8. PROCEDURES FOR SELECTION OF AN OPTIMUM PLAN: This paper deals with the third and final phase of planning studies, referred to in paragraph 1, wherein the most promising plans capable of satisfying the basins needs are analyzed by comparable and successive evaluations to arrive at a plan of development which will maximize net returns in the most efficient manner. The principle of maximization as applied in this study phase requires that the detailed procedures to be followed in forming the plan of development be such as to assure a balanced program of water resources development to satisfy the economic and social needs with a maximized output from minimum investments in productive resources.

9. Two broad methological approaches are generally considered as offering sound bases for the selection of the optimum plan. These are the mathematical model and the sequential appraisals. The basic premise of the mathematical model method assumes that it is possible to construct a direct mathematical correlation among the pertinent variables to be considered in forming the development program. This method can be readily applied in simple cases involving a limited number of production measures and complementary functions. The application of the mathematical model to basin planning is being actively investigated in the academic circles but at the present time it is not applicable to the complete solution of all or a substantial part of the planning job for a major river basin.

10. Closely related to the mathematical model procedure is a method involving a series of repetitive determinations by which it is possible through sequential testing of a project or series of projects to arrive at a reasonable solution, consistent with the principles of project formulation. This method is particularly suited to the principle of maximized net benefits. The procedure to be followed in this case generally can be expressed in a mathematical formula involving differential calculus and the number of separate determinations may be extremely burdensome when the procedure is applied without simplification to the complex analysis of the water resources of an entire river basin. Experiences in the use of a simplified adoption of this method to select optimum plans for the Delaware and Potomac River basins are reported in paragraphs below. The method adopted in these cases involved a set of successive determinations

to establish the composition of the optimum plans of basic productive elements. Detailed appraisals were then made to establish the optimum dimensions of each element.

11. SELECTION OF THE DELAWARE PLAN: Nine promising plans of basic storage and hydro-power projects in the Delaware Basin were formulated with a view to producing, insofar as possible, essentially the same goods and services from the development and use of long-term and short-term impoundments. The elements included in these plans were selected in accordance with their relative worth as determined by preliminary screening procedures and with the geographic distribution necessary to meet the estimated water supply, recreation and flood control requirements in various tributaries and main stem reaches.

12. The elements of these plans were arranged in two phases of constructi in such a manner that the elements of phase I (one) would provide substantial relief from flood losses and meet requirements for supplies of water to the year 1980. The elements of phases I and II were designed to meet the water supply needs to the year 2010. The estimates of water supply requirements use in this case were early estimates that were subsequently refined and modified The use of early estimates was completely acceptable in this case since chang in the demand picture primarily affects the probable timing of construction of the various elements of the plan. The basic composition of these plans is not sensitive to such changes. In later phases of the study the two-phase timing arrangement was abandoned in favor of more accurate fixing of construction times and sequences for the measures included in the selected plan.

13. The active storage capacities for short-term and long-term water impoundments (for all purposes including water supplies for domestic, industrial and rural purposes, and for low flow regulation) were based on empirical relations of flood volume vs. drainage area and the generalized storage-yield relationships prepared during early phases of the hydrology studies. Where warranted by the sustained flows to be anticipated from the storage projects in the plan, run-of-river hydro-power projects were included.

14. In arriving at the best balanced plan for water resources development to insure optimum availability of surface water for every use of water, the first step was the evaluations of the goods and services produced by the several plans under consideration. Such evaluation had to be consistent not only from one plan to the next, but also for the various types of goods and services. This latter requirement led to clarifying assumptions relative to the methods and applicable point of evaluation. For example, the unit of measure had to be defined. This was done by simply assuming that the current dollar value of the needs and services would serve as an adequate unit of measure for a comparative study of the plans of development. Also, the values of the goods and services were based on their monetary values at the point of production. This made estimates of values to the ultimate consumer unnecessary. The results of these appraisals and cost figures for the nine plans are summarized in the accompanying table 1. These values and costs were computed on the basis of systems without any attempt to establish the sequence of construction. Subsequent studies showed that no one sequence could clearly result in a major

TABLE

VALUES OF PRODUCTS AND COSTS OF THEIR PRODUCTION FOR THE PLANS UNDER CONSIDERATION IN THE DELAWARE RIVER BASIN

PLAN	ANNUAL VALUE OF PRODUCTS - $1,000,000					ANNUAL COST OF PRODUCTION - $1,000,000					Net Excess (5)-(10)
							Specific Costs				
	Storage	Recreation	Fish and Wildlife	Hydro-power	Total	Storage	Recreation	Fish and Wildlife	Hydro-power	Total	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
					PHASE I						
A	6.2	8.8	.4	9.9	25.3	5.2	5.9	.6	14.0	25.7	- 0.4
B	5.9	3.2	.3	6.0	15.4	5.5	2.1	.3	11.5	19.6	- 4.2
C	8.4	8.6	.4	7.2	24.6	8.2	5.8	.6	9.1	23.7	+ 0.9
D	5.7	11.7	.2	3.1	20.7	9.4	10.7	.8	5.5	26.4	- 5.7
E	7.0	9.8	.3	6.0	23.1	7.9	6.2	.7	11.5	26.3	- 3.2
F	5.2	8.8	.03	9.0	23.0	8.2	5.9	.5	14.0	28.6	- 5.6
G	7.7	20.1	.4	5.2	33.4	11.8	13.5	.8	7.6	33.7	- 0.3
H	11.2	20.4	.5	10.5	42.6	12.8	13.4	1.1	14.5	41.8	+ 0.8
K	10.9	10.3	.2	33.1	54.5	20.1	6.9	.7	16.6	44.3	+10.2
					PHASE II						
A	7.3	9.5	.3	5.0	22.1	8.9	6.1	.7	7.6	23.3	- 1.2
B	8.1	16.0	.4	8.6	33.1	9.6	10.5	.8	10.0	30.9	+ 2.2
C	6.2	7.8	.3	5.1	19.4	7.0	5.0	.6	7.8	20.4	- 1.0
D	19.9	11.9	.5	19.4	51.7	22.9	7.9	1.0	14.2	46.0	+ 5.7
E	13.4	9.7	.5	11.5	35.1	12.9	8.0	.8	12.4	34.1	+ 1.0
F	9.8	10.2	.5	3.4	23.9	11.1	6.6	.6	2.6	20.9	+ 3.0
G	11.3	12.8	.2	4.4	28.7	16.7	8.2	.8	3.3	29.0	- 0.3
H	5.7	7.6	.2	4.5	18.0	6.4	4.8	.5	6.7	18.4	- 0.4
					PHASE I + II						
A	13.5	18.3	.7	14.9	47.4	14.1	12.0	1.3	21.6	49.0	- 1.6
B	14.0	19.2	.7	14.6	48.5	15.1	12.6	1.3	21.5	50.5	- 2.9
C	14.6	16.4	.7	12.3	44.0	15.2	10.8	1.2	16.9	44.1	- 0.1
D	25.6	23.6	.7	22.4	72.4	32.3	18.6	1.8	19.7	72.4	0.0
E	20.4	19.5	.8	17.5	58.2	20.8	14.2	1.5	23.9	60.4	- 2.2
F	15.0	19.0	.5	12.4	46.9	19.3	12.5	1.1	16.6	49.5	- 2.6
G	19.0	32.9	.6	9.6	62.1	28.5	21.7	1.6	10.9	62.7	- 0.7
H	16.9	28.0	.7	15.0	60.6	19.2	18.2	1.6	21.2	60.2	+ 0.4

economic advantage with respect to the accrual of system net benefits. The values and costs in table 1 were based on the optimistic assumption that a market will exist for all products throughout the economic life of the projects. The hydro-power values and costs were based on the assumed development of hydropower at each site with known power potentials.

15. If the various plans under consideration were so constituted that each would produce exactly the same products on the basis of the appraisals discussed above, the identification of the optimum plan would be simple. It would be that plan that could be expected to yield a balanced production of water resources products and services adequate to satisfy the anticipated needs thereof with the least investment of water resources and funds. The geographic distribution of the worthwhile storage potentials, the wide range in project dimensions and the basic or dominant uses that governed the formulation of some of the plans, all militate against a strict comparison of the plans. Also, the place of pumped-storage hydropower projects in this over-all analyses of comparative schemes was fraught with complexities. For example, this type of project can be developed only at sites with favorable physical features yet these sites may be the less desirable ones from the standpoint of the production of such other goods and services as flood control, water supply and recreation. Furthermore, the very nature of the pumped-storage projects required that deliberate and learned consideration be given to the size and cost of reversible units and other factors unique to that type of development. Thus while the plan designed to provide pumped-storage type of hydropower developments, was considered in the selection of a basic plan for the basin, it was apparent that pumped-storage potentials would have to be analyzed separately as adjuncts to or replacements for elements of a basic plan of development in order to bring the balanced production of goods and services to the optimum.

16. From consideration of the net excesses of benefits with and without power for the various plans under consideration, the over production of water supplies inherent in certain plans and other factors a two phase basic plan was defined which included the following 22 major impoundments:

Phase I:	Sterling	Tocks Island
	Shohola Falls	Tobyhanna
	Basher Kill	Beltzville
	Flat Brook	Bernville
Phase II:	Hawk Mountain	Tohickon
	Paulina	Newtown
	Pequest	Moselem
	Beltzville	French Creek
	Aquashicola	Evansburg
	Trexler	Newark
	Hackettstown	Christiana
	New Hampton	

17. Refined water supply and demand studies made subsequent to the lection of the basic plan showed that the elements included in the basic an would overproduce the supplies of water required to meet the demands. nce the planning principles being followed assumed a market for all oducts of the water resources development, the apparent overproduction water supplies would be without value during the period to 2010. Based the knowledge of the values and costs of such other products and ser- ces as flood control and recreation it was found that the basic plan uld be tailored to best meet the balanced demands for the products under nsideration by initial development of the Paulina, Pequest, Hacketts- wn, New Hampton, Tohickon, Newtown, French Creek and Evansburg sites for creation. This arrangement had the added advantage of assuring the ailability of the storage potentials at these sites when their develop- nt for water supply purposes is indicated. It should be noted that ese assurances are actually of considerable value to the future economy the basin and while these benefits are not included as features of the creation developments at these sites they nevertheless will be substantial l real.

18. The Sterling project in series with the Tocks Island project was und to lack economic justification for flood control purposes and was opped from further consideration in the planning studies. Furthermore, Tobyhanna project in series with the existing Bear Creek project, is nited primarily to water supply and recreation developments and failed compete economically with an alternative proposal for the additional velopment of the products at the existing Bear Creek flood control project mediately downstream. Accordingly, the Tobyhanna project was dropped om further consideration and a project to revise the present Bear Creek velopment added in its stead. Also, because of its extreme economy, a oject to revise the present flood control and recreation development at Prompton dam and reservoir in the Lackawaxen River Basin to include g-term storage for water supply purposes was added to the basic plan. ally, the Blue Marsh project on Tulpehocken Creek in the Schuylkill er Basin was substituted for the Bernville project, immediately up- eam, to eliminate the costly impact of the latter project on the local nomy. The Moselem project on Maiden Creek was shifted, because of e geology, to a new dam site a short distance upstream and renamed den Creek project. Thus the plan used in subsequent detailed planning dies included the following projects:

Hawk Mountain	Trexler	Pequest
Prompton (revision)	Maiden Creek	Hackettstown
Tocks Island	Blue Marsh	New Hampton
Bear Creek (revision)	Newark	Tohickon
Beltzville	Christiana	Newtown
Aquashicola	Paulina	French Creek
Evansburg		

19. SELECTION OF THE POTOMAC PLAN: The plan recommended for the Potomac in evolved from alternatives considered. A comparison of alternative plans

was the first step in the evaluation leading to the selection of the recommended plan. No alternative exists for the Bloomington project in the North Branch. This fact made its recommendation in an interim report possible. This project was authorized in 1962, and is a part of every plan considered.

20. The four plans for Washington Metropolitan Area Water Supply are compared on Table 2. This table shows Plan 1 as the cheapest for both total construction cost and for present worth based on the anticipated time schedules. However, Plan 4 appears to be the best of the four, regardless of its higher cost, because it leaves a minimum flow in the river sufficient to maintain today's water quality and, most of all, because of its adaptability and flexibility. The local benefits which would result from this plan would probably make it more acceptable to the upstream regions of the Potomac Basin.

TABLE 2

COMPARISON OF WASHINGTON METROPOLITAN AREA WATER SUPPLY PLANS

Plan	Minimum Flow in River 1/ (cfs)	Construction Cost 2/ (million dollars)	Present Worth (million dollars)	Remarks
1	400	63.6	48.4	Lowest cost
2	400	83.3	53.3	Very flexible
3	1000	78.2	78.2	Least flexible
4	1000	164.4	102.6	Most adaptable and flexible

1/ With average water supply withdrawal. For minimum flows with peak water supply demand, subtract 400 cfs.

2/ Allocated to Washington Metropolitan Area Water Supply.

21. The next point of comparison is shown on Table 3. Here, the construction costs to the Metropolitan Area for water supply are compared between the lowest cost single purpose plan and the three basin-wide multiple purpose plans.

TABLE 3

COMPARISON OF SINGLE PURPOSE AND MULTIPLE PURPOSE PLANS FOR WASHINGTON METROPOLITAN AREA WATER SUPPLY

Plan	Construction Cost 1/ (million dollars)
Single Purpose Plan 1	63.6
Main Stem Upper Basin	27.7
Major Tributary	29.4
Upper Basin	31.4

1/ Allocated to Washington Metropolitan Area Water Supply

310-315 O-61-27

22. The share of construction costs of any of the basin-wide multiple purpose plans, pro rated to the Washington Metropolitan Area for its water supply, is cheaper than the cost for a single purpose water supply plan for only the Metropolitan Area. From the standpoint of cost to the Metropolitan Area, the basin-wide plans are more economical and thus further considerations for recommendation were limited to the basin-wide plans only.

23. An economic comparison of the basin-wide plans directly from the cost and benefit data would not be possible except for the total first cost of each plan. In order to provide a common basis for comparison of the plans, the costs to be incurred and benefits expected to accrue during the period starting with the beginning of the first project to the end of the 50-year economic life of the last project were reduced to their present worth at the beginning of the period. In all plans, this period is 92 years. Beyond the 50-year economic life of each project, the costs incurred would be only for operation, maintenance and major replacements, as the final charges on the investment are considered to have ended after year 50. The benefits to each project are considered to be a constant annual amount after year 50 equal to the annual benefit which would accrue in year 50. This procedure permits a monetary comparison of each plan. The value for costs and benefits thus computed are comparable to each other, but are no measure of the costs and benefits in an absolute sense, as these computed values are valid only in their relationship to each other. Table 4 shows a comparison of the benefits and costs of the three alternative basin-wide plans, expressed as the present worth, at the beginning of the first project, of 92 years operation of each plan.

24. As indicated by Table 4, the Main Stem and Upper Basin Plan and the Major Tributary Plan have the same benefit to cost ratio, but with the Main Stem Plan having about 2 percent greater excess or net benefits. The total first cost for the Main Stem Plan is also about 8 percent less than the Major Tributary Plan. The Upper Basin Plan ranks third in all respects. Therefore, the Main Stem Plan is the best plan of the three from a strictly economic sense. First, its total construction cost would be less; second, it would produce a greater excess of benefits over cost and, last, the rate of benefits provided per dollar expended would be the highest. Therefore, the Main Stem and Upper Basin Plan was selected as the best from the strictly economic viewpoint. But economics, expressed in monetary terms, are only one part of the comparison process. All aspects of the plan, viewpoints of other agencies, and local desires must be considered.

TABLE 4

ECONOMIC COMPARISON OF ALTERNATIVE BASIN-WIDE PLANS 1/
(Costs and benefits in millions of dollars)

Plan	Total Construction Cost	Capitalized Worth in 1965 2/ Costs	Capitalized Worth in 1965 2/ Benefits	Benefit to Cost Ratio	Excess Benefits
Main Stem and Upper Basin	346	430	897	2.1	$467
Major Tributary	378	423	881	2.1	458
Upper Basin	405	446	881	2.0	435

1/ Major reservoirs only.

2/ Includes interest, amortization, operation, maintenance and major replacements.

25. An appraisal of the non-monetary effects, advantages and disadvantages shows that it would be extremely difficult, if not impossible, to design a water resource development system for the Potomac in which some local adverse impact would not occur. Technically and economically feasible reservoir sites are scarce. The degree of human occupance and use of all these potential sites precluded the development of a plan without some temporary losses in local areas. No alternative plan would meet the demands for water resource services without these losses being sustained. The three basin-wide plans were rated for 13 items of comparability. This comparison showed the Main Stem and Upper Basin Plan superior to the others, with the Upper Basin Plan second. In spite of its favorable rating, the Main Stem and Upper Basin Plan scored low in recreation benefits and high in adverse impacts. An analysis of the factors contributing to these ratings revealed that the largest part of the adverse impacts of the Main Stem and Upper Basin Plan would be concentrated in the Riverbend Project, and that recreation opportunities in this plan would be distributed along the periphery of the Basin, leaving a large void in the center.

26. This uneven distribution of beneficial and adverse effects indicated that this plan was not fully meeting the objective. The third element of the objective is out of balance, so that the Main Stem and Upper Basin Plan does not provide the optimum contribution.

27. As stated previously, no appropriate developmental alternatives were found for the basic ten reservoirs common to all plans. This lack of alternatives, plus the fact that they are needed in any plan to fulfill the upstream water requirements, makes these 10 major reservoir projects the basic elements in any comprehensive plan. By this same reasoning, the 418 headwater reservoirs become the second group of basic elements. These two groups of projects would satisfy specific water needs near their location and concurrentl would provide about one-third of the flow required at the Washington Metropolit Area. It is in satisfying the unfulfilled requirement that modifications of th

alternative plans were possible. The economic comparisons previously presented favored the Main Stem and Upper Basin Plan over the other two by a small margin. This was sufficient to consider this plan as satisfactory with respect to the first two elements of the stated objective, namely, maximization of net benefits while meeting the stated needs, and the use of resources to their full economic and physical potentials. However, none of the plans were satisfactory with respect to the third element of the objective - optimum distribution of beneficial and adverse effects. With this in mind, two elements of the Main Stem and Upper Basin Plan - Riverbend and Royal Glen projects - were considered for modification. Because of the greater over-all beneficial effect of providing flood control for Petersburg, West Virginia, by reservoir storage rather than local protection, as well as to retain flood protection for portions of the South Branch Valley, the Royal Glen Reservoir was not changed. This decision was further strengthened by the fact that the adverse social impact of the Royal Glen project would be moderate, while the beneficial economic impact in that area of West Virginia could be extensive. This decision left Riverbend Reservoir as the only element subject to modification.

28. One of the major adverse effects of the Riverbend project would be the inundation of a portion of the C & O Canal. While this was considered one of the adverse impacts, it was not the most significant. Temporary changes in the tax base of affected counties, displacement of persons from a relatively highly developed area and the resulting adverse social and economic impact, and changes in the established types of economic pursuits were considered to be more meaningful. As previously indicated, complete rejection of this project would not necessarily reduce these impacts from a basin-wide point of view, as some of the alternative projects would possibly have a greater adverse effect, over all. Apart from the local adverse effects of the Riverbend Reservoir, removal of this project from the plan would reduce the degree of flood control provided for the Washington Metropolitan Area and alter the geographically distributed balance of cost and benefits. Substitute protection through local protective works was found to be not economical. Based upon the foregoing considerations, and to mitigate the adverse effects of Riverbend while assuring adequate protection for the Washington Metropolitan Area against flood hazards, it was found practical to adopt another site location four miles upstream from the Riverbend site near the mouth of Seneca Creek.

29. The Seneca Dam would be located about 4 miles farther upstream than Riverbend, thus preserving most of the presently water filled portion of the C & O Canal. This 4 mile reach is also one of the most heavily developed sections of the Riverbend Reservoir area.

30. Since the maximum water surface level is limited to the same elevation in either reservoir by the cost of relocations, the total storage potential of the Seneca Reservoir is less than that of Riverbend by the amount which would have been in the 4 mile stretch between the two dams. Maintaining the same flood control provisions in the Seneca Reservoir placed a limit on the amount of storage available for low flow augmentation. As a result of this limit, the amount of long-term storage for flow regulation in the Seneca Reservoir

would be 158,000 acre-feet less than that in Riverbend. This means a reduction of 450 cubic feet per second in regulated flow needed for water supply and water quality demands at the Washington Metropolitan Area. Four additional projects were then added to the plan to make up this flow deficiency. The four projects were selected from those considered in other plans with the view of adding the greatest over-all beneficial effect with the least adverse effect. The four projects added were: Town Creek, North Mountain, Tonoloway Creek and Licking Creek. These projects were scaled to provide sufficient storage to make up the difference in the reduced yield of the plan resulting from substitution of the Seneca project for that at Riverbend.

31. INDIVIDUAL SITE MAXIMIZATION FOR THE DELAWARE PLAN: Individual site maximization procedures were systematically applied to each major impoundment site considered in this phase of the analysis employing the appropriate benefit and cost values. The results of these studies are shown graphically in plate 2. Each figure on this plate shows for each of the major impoundment sites the range of net benefit accrual at each site with respect to a series of short-term/long-term allocations. The point at which the net benefit accrual is maximized is labelled Maximum in each figure. At these points the differential between total project costs and total project benefits is at a maximum. The pertinent data for each site at its maximized scale of physical development are shown below in table 5.

TABLE 5

SCALES OF DEVELOPMENT
INDICATED BY INDIVIDUAL SITE MAXIMIZATION

Project	Inactive (ac.ft.)	Long-Term (ac.ft.)	Short-Term (ac.ft.)	Total Capacity (ac.ft.)
Beltzville	1,200	60,000	25,000	86,200
Aquashicola	1,000	31,000	20,000	52,000
Trexler	800	24,200	10,000	35,000
Blue Marsh	1,500	28,500	19,000	49,000
Maiden Creek	2,000	78,000	30,000	110,000
Tocks Island	80,000	440,000	250,000	770,000
Bear Creek	2,000	70,000	108,000	180,000

The particular allocations of storage indicated in the above table represent those levels of development indicated by maximization of net monetary returns. It is recognized, however, that there are some areas of the benefit picture which are not directly susceptible to monetary appraisal. Such intangible benefits, while not entering directly into the maximization analysis, had to be taken into consideration in order to assure a truly balanced plan for optimum satisfaction of all water resources needs. Modification of maximized scales of development to allow for such intangibles are discussed in the following paragraphs.

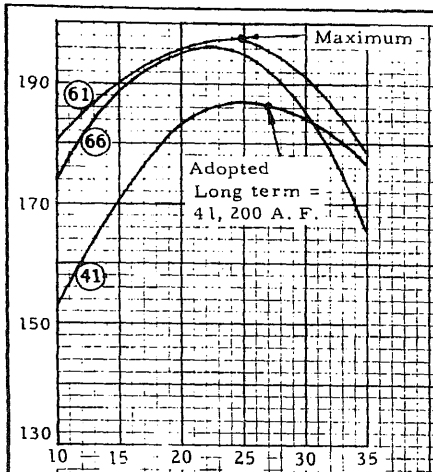


Fig. 1 BELTZVILLE

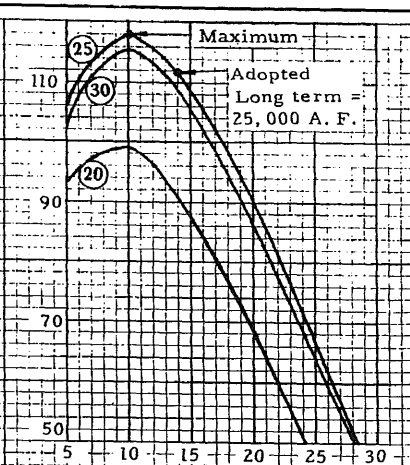


Fig. 2 TREXLER

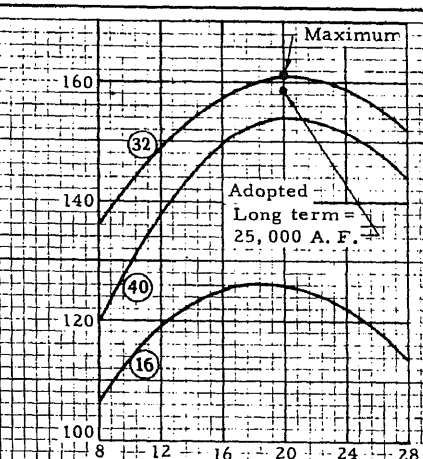


Fig. 3 AQUASHICOLA

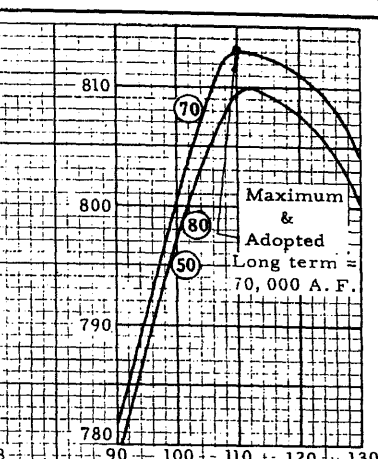


Fig. 4 BEAR CREEK

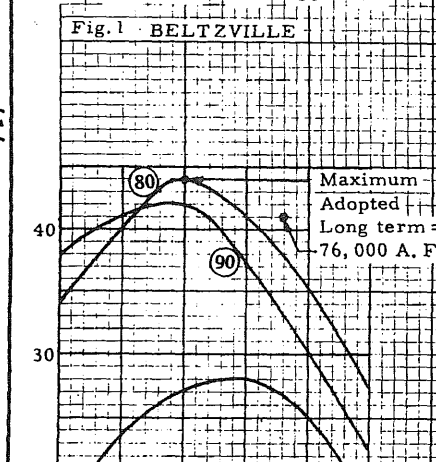


Fig. 5 MAIDEN CREEK

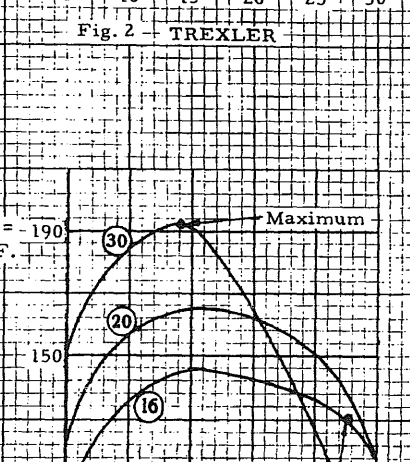


Fig. 6 BLUE MARSH

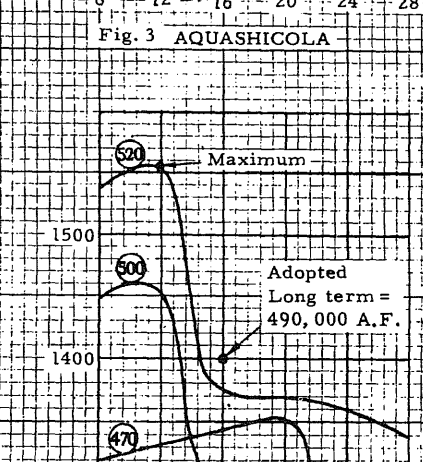


Fig. 7 TOCKS ISLAND

LEGEND:

(15) Designates long term storage allocation in 1000 acre feet.

All vertical scales -- NET BENEFITS ($1000)

All horizontal scales -- SHORT TERM STORAGE (1000 A.F.)

REVIEW REPORT
DELAWARE RIVER BASIN
MAXIMIZATION OF
NET BENEFITS FOR
INDIVIDUAL SITES

In'l Sheet — Scales as shown
Corps of Engineers, Philadelphia, Pa. — Philadelphia District, 30 Dec. 1959
Drawer No. 228 — File No. 29355

PLATE 82

414

32. Of particular significance in the evaluation of the maximization studies is the apparent flatness of the net benefit accrual curves around the point of net benefit maximization. This can be seen in figures 1 and 3 of plate 2 for the Beltzville project and Aquashicola project, respectively. For instance, on the Beltzville project (figure 1), a reduction by as much as 32 percent in the long-term storage allocation at the 61,000 acre-foot allocation where net benefits are maximized would only result in the loss of $10,000 of annual net benefits, only about a 5 percent reduction from the maximum excess estimate of $197,000. Similarly a 40 percent reduction in the short-term storage allocation for the Beltzville site, holding long-term storage at the maximum level, would result in a loss of annual net benefits of $7,000, a $3\frac{1}{2}$ percent reduction from the maximized point. For the Aquashicola project (figure 3), a reduction of long-term storage by 20 percent from that project's net benefit maximization point leaves the net benefit estimate virtually unchanged. A reduction of the same percentage in the short-term storage allocation would only reduce net benefits at Aquashicola by $2\frac{1}{2}$ percent.

33. Conversely, increases in storage allocations do not always appear to severely alter the level of net benefit accrual. For instance, for the Trexler project (figure 2), an increase of short-term storage from 10,000 acre-feet to 14,000 acre-feet, a 40 percent increase in the short-term storage allocation, only reduces annual net benefits by $6,000, about 5 percent of the $118,000 net benefit level at the maximum point. A 20 percent increase in Trexler's long-term storage allocation results in a benefit reduction of $2,000, almost no loss of net benefits. On the other hand, changes of storage allocations for the Blue Marsh project from its maximized level results in major modifications in the net benefit estimates. For instance, an increase of short-term storage from 19,000 acre-feet to 25,000 acre-feet, an increase in short-term storage of 32 percent, results in a loss of $27,000 of annual net benefits, 14 percent of the total excess benefits at Blue Marsh's level of optimum development. For the Tocks Island project the unusual capacity-cost relationship reflecting the cost of protective work in the vicinity of Matamoras and Port Jervis resulted in a relatively confined area, as shown by figure 7, within which net benefits can be maximized.

34. The importance of the apparent flatness and other peculiarities of net benefit accrual curves around each site's point of net benefit maximization is that it will not be possible to make modifications in the scale of development at any one site from the maximized level without altering the maximized net benefit estimate. However, the zone of maximization permitted the necessary scale of development changes at each site so that it was possible to determine a system of projects that would achieve a balanced program of development without seriously violating maximization principles.

35. While for the purposes of this phase of the forming of the plan of development a single level of physical development for each major impoundment site was identified as the level with the greatest net benefit accrual, the results of these studies, as noted above, indicates that for each project there existed a range or zone of other levels of development where the difference between net benefits at the maximum level and at some lesser level was very

it reduction. On a prima facie basis it would project selected for inclusion as an integral unit ...cts be developed exactly to the scale of development excess benefits. It was fully recognized, however, that ...t would be possible to choose the final dimensions of any one site to ...ded within a system, it would be necessary to reevaluate each site ect to its contribution in the attainment of a balanced program of development which could not be fully evaluated within the constraints of the individual site maximization studies. Two major areas considered in the re-evaluation of the dimensions of the impoundment sites were (1) the degree of flood control protection to be afforded from each site in relation to desirable levels of production indicated by other criteria and (2) the adequacy of the several projects considered as a system in meeting the 50-year time pattern of net surface water requirements for water supply. Another equally important consideration was the cultural or geographic limitations of individual site development that could not be fully evaluated in monetary terms in the maximization studies. The following paragraphs will indicate the nature of such modifications and the reasons behind each. Following this, the results of these modifications are summarized with respect to the resultant changes in over-all net benefit accruals.

36. Studies were first undertaken to determine the effectiveness of each project, sized in accordance with the results of the individual maximization, to reduce or control flood flows in terms of the degree of reduction of the Standard Project Flood for each site. Based upon the short-term storage allocations from maximization studies associated with the reduction of flood damages, the following determinations were made:

Project	Short-Term Storage (ac.ft.)	Degree of Protection * (percent)
Tocks Island	250,000	50
Beltzville	25,000	62
Aquashicola	20,000	77
Trexler	10,000	51
Maiden Creek	30,000	46
Blue Marsh	19,000	32
Bear Creek	108,000	70

* The extent to which the volume of the Standard Project Flood at the site can be impounded. Complete impoundment = 100%

hile it was recognized that the short-term storage allocations indicated bove contributed to the production of the maximum net excess benefits for ach site, it was still necessary to give further attention to the possibility f a higher degree protection to be afforded to downstream reaches in excess f the protection achieved solely through the short-term allocations based on he results of the maximization studies. The attainment of a balanced program

for flood damage reduction could not be evaluated on economic efficiency criteria alone. The presence of major urban development in downstream reaches from each of the major impoundment sites required, in addition to providing the greatest dollar damage reduction for each dollar of investment, a sufficiently high degree of protection so as not to create any false sense of security that would possibly aggravate the flood problem.

37. In light of these considerations short-term storage allocations at the Beltzville, Trexler, Maiden Creek, and Blue Marsh projects were modified to provide additional short-term capacity thereby increasing the degree of protection. Wherever possible, these modifications were made within each project's zone of maximization so that the net result would be to increase the degree of protection while at the same time minimize the loss of net benefits. The results of these modifications are shown below:

Project	Short-Term Storage (ac.ft.)	Degree of Protection (percent)
Tocks Island	275,000	54
Beltzville	27,000	71
Aquashicola	20,000	77
Trexler	14,000	66
Maiden Creek	38,000	55
Blue Marsh	33,000	52
Bear Creek	108,000	70

38. Modifications were also undertaken on the long-term storage allocations to adjust for geographic and cultural limitations on site development and to insure that the yield to be produced from each site considered as integral parts of a system would be no more than needed to satisfy net surface water requirements by the year 2010. The former type modifications were necessitated by the several modifications made in short-term allocations as indicated above in paragraph 37.

39. At the Blue Marsh site, it was found necessary to reduce long-term storage from 30,000 acre-feet at the maximized point to 16,000 acre-feet, a net reduction of 14,000 acre-feet. The maximization studies at this site reflect the prohibitively high cost of project developments in excess of total storage capacity of 50,000 acre-feet due to the cost of protecting or relocating the town of Bernville, Pennsylvania, for the higher development capacities. Inasmuch as it was desirable to increase Blue Marsh's short-term allocation by 14,000 acre-feet to provide a reasonable degree of flood control protection, it was necessary to reduce the long-term allocation by a similar amount. In this way it was possible to achieve a reasonable degree of flood control protection with minimal loss of net benefit accrual. Any other reallocation of long-term capacity with respect to the required short-term modification would have resulted in further losses of net benefits. While the evaluation used for long-term and short-term storage showed a substantial reduction in

the net benefits for the modified storage allocations, these net benefit reductions would be minimized or possibly eliminated if methods were available for monetary appraisal of the assurance value of reasonable degrees of flood control. A loss of net yield for water supply resulted also from these modifications, but the modified long-term storage would provide sufficient yield at this site to satisfy that area's water demands with the Maiden Creek project also considered. At the Maiden Creek site, a slight reduction of long-term storage was undertaken to minimize the loss of net benefits as a consequence of modification of Maiden Creek's short-term capacity. Long-term storage was reduced from 80,000 acre-feet to 76,000 acre-feet, with a resultant loss of yield of approximately only 2 c.f.s. This, however, did minimize the reduction of net benefits.

40. As indicated previously there existed a limitation on development of the site at Tocks Island beyond elevation 428 where the cost of protecting the Port Jervis area prohibited economically justified developments in terms of net benefit accrual. Since it was necessary to increase the short-term allocation at Tocks Island by 25,000 acre-feet to afford a higher degree of flood control protection, it was also necessary to adjust the long-term allocation so as to keep the pool elevation within the critical level. The long-term allocation therefore suffered a reduction of approximately 30,000 acre-feet. The loss of both net benefits and net yield as a consequence of these modifications were minor by comparison with this site's over-all ability to contribute to the balanced program of resource development for this basin.

41. In the case of the projects in the Lehigh River basin, (Aquashicola, Bear Creek, Beltzville and Trexler), modifications of long-term storage were indicated since the cumulative sum of net yields from each of these projects individually maximized would be in excess of the augmentation requirement from these sites to satisfy both the water supply demands in the Lehigh and Trenton-Philadelphia areas by 2010. From the results of the maximization studies these four sites could produce a net yield of 433 c.f.s. However, a combined net yield of only 408 c.f.s. was considered adequate to satisfy the augmentation requirements. Within the environments of this study it would be necessary to reduce the combined net yield by 25 c.f.s. so that only the required augmentation would be produced. However, with expected increased in water needs after year 2010 such reduction seemed unreasonable at this stage of planning for the development of the basin's water resources and, accordingly, was not made a feature of this study.

42. Since the yield at any one site could be directly substituted for yield from any of the remaining sites, it was only necessary to study the relative efficiency of the site's ability to produce net yields and reduce the net yield excess from those sites with the lowest relative efficiency. The results of the maximization studies did reveal, however, that Bear Creek possessed a unique economic advantage in its relative efficiency to produce a unit of yield. It was evident that no advantage would be obtained by reducing Bear Creek's yield from its maximized level. On the other hand, while it could be argued to increase the yield of Bear Creek at the expense of larger reductions at the other sites to achieve the desired augmentation of 408 c.f.s. in an

efficient fashion, the results of such modifications would seriously impair the ability of the downstream Trexler, Beltzville and Aquashicola sites to produce flood damage reduction and recreation on an economically justified basis. The relative loss in the production of flood control and recreation benefits at these sites would be greater than the efficiency gained in producing more water supply yield at Bear Creek. Based upon these considerations no modifications were made on Bear Creek's long-term storage allocation of 72,000 acre-feet, capable of producing 208 c.f.s. of net yield. With Bear Creek fixed at a level of 208 c.f.s. it was then necessary to reduce the net yield from the remaining sites by 25 c.f.s. so that the combined net yield of the three sites would equal 200 c.f.s.

43. To select the final dimensions of the Trexler, Aquashicola, and Beltzville sites to produce a combined net yield of 200 c.f.s. required a special maximization study of these three sites in combination. Short-term storage allocations for each site were set at their modified levels as discussed in paragraph 37. For each site a series of net yield levels were arrived at by varying the long-term storage allocation. The net benefit accrual for each level of yield for each site was then computed in accordance with maximization procedures discussed earlier. It was then possible to develop a series of combinations of the three projects with each combination always producing 200 c.f.s. For each such combination a total net benefit estimate was also computed.

44. Employing increments of 5 c.f.s net benefit estimates were computed for over 200 different combinations of the three reservoirs scaled to varying degrees of long-term storage allocation each combination producing 200 c.f.s. It should be noted, however, that while the degree of flood protection remained constant throughout, as well as the cumulative net yield, variations did occur in the level of net recreation benefits which were directly related to the level of long-term storage for each major site. That combination which produced the maximum excess benefits was selected as the final basis for modification of long-term storage at these sites so that the required flow of 200 c.f.s. from these sites would be secured. This combination called for a net yield of 55 c.f.s. from the Trexler site, requiring a long-term storage allocation of 25,000 acre-feet exactly equal to the allocation arrived at in the original maximization study. From the Beltzville site, a yield of 82 c.f.s. would be required associated with 41,200 acre-feet of long-term storage, 20,000 acre-feet less than the allocation in the maximization studies. Lastly, a requirement of 63 c.f.s. was determined for the Aquashicola site, associated with 25,000 acre-feet of long-term storage, some 7,000 acre-feet less than the allocation of 32,000 acre-feet determined in the course of the maximization studies.

45. Throughout the process of storage modifications careful note was taken of the changes occurring in the level of net benefit accrual as the level of development for each site varied. The goal of these modifications was not only to provide bases for fixing the dimensions of the individual projects within the realities of the planning environments but also to establish

storage allocations designed to optimize, within practical limits, the net benefits. Since for most sites there existed a rather broad zone of maximization, modifications in storage allocations were possible without serious effect on the net benefits. The results of the above mentioned modifications in long- and short-term storage allocations in terms of net benefit reduction are given below and are shown on plate 2, page 414.

NET BENEFITS

Project	Individually Maximized	Modified
Tocks Island	$1,550,000	$1,400,000
Beltzville	197,000	185,500
Aquashicola	160,500	159,000
Trexler	118,000	111,000
Maiden Creek	44,000	41,000
Blue Marsh	191,000	114,000
Bear Creek	813,000	No Change

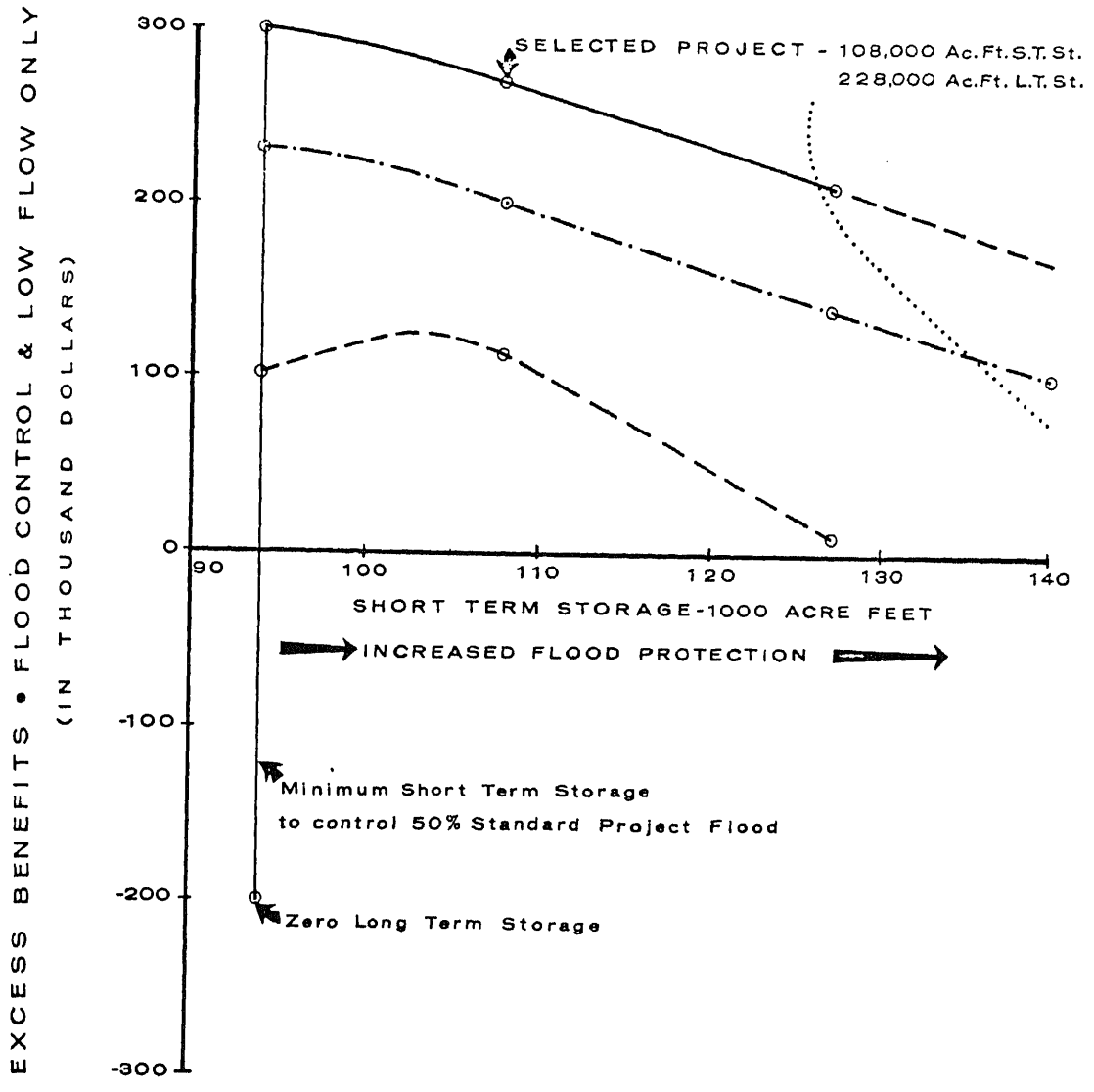
The adopted storage allocations showed an over-all reduction of eight percent in net benefits from the maximum established for the seven projects by the maximization studies.

46. INDIVIDUAL SITE MAXIMIZATION FOR THE POTOMAC PLAN: The scale of development was made the subject of careful analysis to insure "optimum contribution" of the system and each project in it. All projects were shown to supply their "optimum contribution." Plate 3* illustrates this analysis for the Royal Glen Reservoir. This figure shows that the selected project has maximized low flow benefits. Any increase in low flow (long term) storage would decrease net benefits. It also shows that flood control (short term) storage was selected as a compromise between minimum short term storage (94,000 acre-feet) which would produce maximum net benefits and maximum justifiable short term storage (126,000 acre-feet). This decision was based on intangible factors such as the safety and security of the inhabitants of the urban areas to be protected.

47. A comparison of the present worths of costs and benefits of this plan and the Main Stem and Upper Basin Plan for the 92 year operation period was made in a manner similar to that shown previously for the three alternative plans.
The selected plan was compared only with the one alternative since that alternative was the most economical. Although the total cost of the Recommended Plan is greater, it is still more economical than the best alternative plan. The Recommended Plan has the same benefit to cost ratio as the Main Stem and Upper Basin Plan, and it showed much more than a marginal improvement in net benefits over the other alternatives. The Recommended Plan is economically more favorable than any of the other three alternatives. It satisfies to the greatest degree the first two elements of the objective by providing maximum net benefits in meeting the stated needs and by making use of the resources necessary to carry out the development program to the limit of their full economic and physical potentials.

* Plate 3 is page 421.

MAXIMIZATION ANALYSIS - ROYAL GLEN PROJECT



NOTES:

- — — Limit of justification for Low Flow; 75,000 Acre Feet Long Term Storage. With less incremental Long Term Storage, excess Low Flow Benefit is negative.
- —·—·— 150,000 and 300,000 Acre Feet Long Term Storage
- ——— 250,000 Acre Feet Long Term Storage
- ····· Limit of incremental justification for Flood Control. With more incremental Short Term Storage, excess Flood Control Benefit is negative.

PRINCIPLES UNDERLYING LEGISLATIVE POLICIES GOVERNING FEDERAL ASSUMPTION OF RESPONSIBILITIES IN THE FIELD OF WATER RESOURCES DEVELOPMENT

By

Howard L. Cook*

Introduction

A subsequent paper will cover existing policies on cost apportionment (i.e., cost-sharing) for various purposes of water resource development. To avoid repetition the subject matter of this paper is confined to the basic principles, or reasoning, which led to the adoption of those cost-sharing policies. These underlying principles reveal the general philosophy of the Congress on the proper role of the Federal Government in resource development. An understanding of this philosophy is of value in interpreting existing legislative policies, and it is an absolute necessity in the development of administrative policies - particularly when those policies are to be proposed for the approval of Congress in the form of reports recommending authorization of specific projects or plans.

How Legislative Policy is Made

Under the division of powers established by the Constitution, basic national policy is made by the Legislative Branch. Within the limitations of policy set by the Congress the Chief Executive has power to establish those administrative policies necessary to the carrying out of the legislative policies. The Supreme Court, of course, makes the final decision in the event the constitutionality of a policy is questioned, and the effect of Court decisions over a period of 140 years has been to progressively broaden the role of the Federal Government in resource development.

The Congress establishes policy in two ways. In some legislative acts it includes a formal statement of policy. Section 1 of the Flood Control Act of 1936 is such a statement. It announced the basic policy that the Federal Government would accept a high degree of responsibility for controlling floods throughout the Nation "in cooperation with States, their political subdivisions, and localities thereof." But the Congress also makes policy by repeatedly authorizing Federal agencies to carry out certain projects or activities. After a sufficient lapse of time in which there have been no conflicting actions by the Congress, it is usually considered that a firm Congressional policy has been established.

Congress also, upon occasion, will stoutly maintain one policy in legislation and follow a contradictory one in the appropriation of funds and the authorization of specific projects. An often cited example of this quaint practice is the manner in which Congress dealt with the problem of the Mississippi River in the interval extending from about 1840 to 1917. Throughout that period it steadfastly supported, in its legislative acts, the contention that expenditures of Federal funds for flood control would be unconstitutional. But throughout the latter portion of the period it

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* Chief, Policy and Legislative Branch, Planning Division, Office of the Chief of Engineers

appropriated funds for works which, as it was fully aware and as it desired, were being used for the control of floods.

In addition to illustrating the way in which Congress occasionally avoids meeting difficult issues, the foregoing example shows why some historical background is essential to an understanding of the present role of the Federal Government in resource development.

Historical Background

In the years immediately following the adoption of the Constitution there existed widely divergent opinions as to the powers that could be, or should be, assumed by the new central government. Insofar as resource development was concerned, it was generally considered that the Federal Government was barred from undertaking "internal improvements," or public works. The first breach in the barrier was made by a famous decision*, written by Chief Justice John Marshall, in 1824, in which the Supreme Court found that, under the commerce clause of the Constitution, "the power of Congress . . . comprehends navigation within the limits of every State in the Union." In that same year the Congress gave the Corps of Engineers its first appropriation for river improvement.

For 78 years after the Marshall decision the Congress confined itself to authorizing only those projects represented as coming under the "commerce clause" - although, as has already been mentioned, it was obvious that in some instances navigation was not the only purpose served. In 1902 the scope of Federal responsibility was broadened by passage of the Reclamation Act. The constitutional basis for this Act was the "property clause," since it was originally intended to confine the program to the improvement of lands owned by the Federal Government.

Although great pressure had been exerted as early as the 1840's to obtain Federal assistance in controlling the floods of the Mississippi River, it was not until 1917 that Congress authorized Federal assumption of responsibility for flood control on this stream and on the Sacramento River. This was 93 years after the Marshall decision. In 1928 the Mississippi authorization was broadened, and in 1936 the Congress passed the first general flood control act. Thus there was an interval of 112 years between Federal assumption of responsibility for navigation and for flood control on a nationwide basis.

After the 1936 breakthrough the way was open for a rapid expansion in the scope of Federal activities in the water field. The Flood Control Act of 1938 made it possible to add power generating facilities to Federal Reservoir projects. The 1944 Act authorized disposal of "surplus" water for domestic and industrial use, and the 1958 Act provided a more clear-cut authority to add capacity for storage of water supply in Federal reservoirs. The 1944 Act also made it possible for the Federal Government to improve major channels so that local entities would have better outfalls for the drainage systems

or wished to install. The use of Federal reservoirs for [illegible] was also authorized by the 1944 Act. In 1946 the first shore protection legislation was enacted, and this authority was broadened in 1956 and 1962. In 1955 hurricane protection was added to the array of problems eligible for study by the Federal Government and in 1958 the Congress began to authorize Federal projects for this purpose. The inclusion in Federal projects of measures to prevent damage to the fish and wildlife resource was authorized in 1946, and in 1958 this legislation was broadened so that provisions could be made for the enhancement of that resource. In 1961 the Congress authorized the inclusion in Federal reservoirs of additional capacity to provide water to be released for "quality control."

This brief review serves to indicate that in the relatively short period between 1936 and 1962 the Congress made it possible to at least consider all of the main purposes that may be served by water resource development. It is important to note, however, that after authorizing Federal participation in navigation, reclamation, and flood control, the Congress made other purposes eligible for inclusion in Federal projects on the grounds that they could be added to Federal projects undertaken primarily for one of the first three purposes. The Congress has never taken advantage, in basic legislation at least, of indications that the Supreme Court would be willing to accept the "welfare clause" of the Constitution as a legal basis for water development*.

Underlying Principles

In accepting various degrees of Federal responsibility in the water field the Congress has followed certain principles which become apparent only when the whole body of legislation is examined with a view to discerning some underlying general philosophy. The results of such an examination will be briefly outlined.

General Philosophy

The general legislative philosophy running through the vast agglomeration of law now on the statute books seems to be about as follows:

1. In general the Federal Government should limit itself to doing those things which cannot be accomplished, or efficiently accomplished, by governmental entities of lower level, or by private enterprise. The most celebrated statement of this basic principle is attributed to Abraham Lincoln, who stated it thusly:

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* In 1950 the Court included in its decision on the Gerlach case the dictum: "Thus the power of Congress to promote the general welfare through large scale projects for reclamation, irrigation, and other internal improvments, is now as clear and ample as its power to accomplish the same results indirectly through resort to strained interpretation of the power over navigation."

"The legitimate object of government is to do for a community of people whatever they need to have done, but cannot do at all, or cannot so well do, for themselves".

This axiom provides a test by which the reasonableness of any project proposal may be judged.

2. The converse of the above is, obviously, that non-Federal entities should do all that they reasonably can to help themselves.

3. Another basic principle, or attitude, reflected in various Congressional actions is that Federal contributions should not result in unconscionable "windfalls" to individuals or to small groups.

4. The Congress also accepts the idea that those who cause a problem should bear the primary responsibility for solving it. This is the basic philosophy underlying the Federal Pollution Control Acts.

5. Acceptable also to the Congress is the idea that it is proper for the Federal Government to bear a part of the cost of projects and programs that benefit the Nation as a whole, or are necessary to protect the interests of future generations, and that would probably not otherwise be undertaken. Examples are the preservation of the fish and wildlife resource, the conservation of the soil resource, and the preservation of wilderness areas. Frequently linked with this idea is the concept that the activities to be placed in this category are ordinarily those in which private enterprise does not operate.

6. Insofar as Federal water projects may destroy values in which there is a generally acknowledged public interest, the Congress believes that mitigation or compensation should be at Federal expense. An example is the expressed willingness of Congress that the Federal Treasury shall bear the cost of mitigating damage to fish and wildlife. (In this connection, it is interesting to note that there is a strong trend toward abandonment of the long-standing doctrine that the Federal Government should not compensate for "consequential damages.")

7. The Congress sometimes brings the Federal Government into activities also carried out by private enterprise in order to provide "competition." An example is the Federal power system in the Tennessee River Basin which is often said to provide a "yardstick" for power rates. Other examples may be found among the earlier inland waterways some of which were admittedly authorized in order to force down rail rates.

8. Congress' actions show that it is usually willing to authorize Federal agencies to construct works for which non-Federal entities are ready to pay. Moreover, it rarely hesitates to subsidize these works through permitting repayment at lower interest rates than the non-Federal entity would have to pay if it undertook the construction itself.

9. The Congress is extremely reluctant to accept primary responsibility for any functions other than navigation, reclamation, or flood control. Yet it is perfectly willing to have water supply, recreation and other functions provided for in plans for projects which it can consider undertaken primarily for those purposes. In utilizing this "add-on" principle, however, the Congress goes to considerable pains to make it clear that primary responsibility remains with non-Federal entities. For example, in authorizing the addition to Federal reservoirs of capacity for storing water for municipal and industrial supplies the Congress prefaced the legislation with:

> "It is hereby declared to be the policy of the Congress to recognize the primary responsibilities of the States and local interests in developing water supplies for domestic, municipal, industrial, and other purposes. . . ."*

10. Although the Congress is not willing to put all purposes on a par, insofar as Federal participation is concerned, it has made it clear that it esires comprehensive river basin plans to embrace all purposes and all eeded projects, including those that are to be constructed by non-Federal entities.

11. A concept often presented as a basic principle is that the Federal share of responsibility should be in proportion to the national interest in the undertaking. The Task Group on Flood Control set up to advise the Hoover Commission pointed out the weakness of this proposal in the following language:

> "The idea of a Federal contribution proportional to the "national interest" fails to provide a usable basis for cost assignment because: (1) In the ultimate analysis all benefits of resource development projects accrue to individuals; (2) The benefit to the Nation is, therefore, made up of the sum of the benefits to the individual citizens of the Nation; (3) It follows that: all benefits are in the national interest; the National interest is not something separate and apart from the interests of individual beneficiaries; and thus no specified fraction of the total benefits can be said to represent the value of a project to the Nation as such."**

Principles Applicable to Project Proposals

When a Federal agency has authority to recommend the authorization of a specific plan it may, of course, propose such degree of Federal participation for any purpose or project that it may consider warranted by the

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*Water Supply Act of 1958

**Task Force Report On Water Resources and Power, Volume 2, p. 758

attendant circumstances. Past actions of Congress indicate that the following principles may be used as a guide in developing specific recommendations:

1. When the benefits of a project are "widespread and general" the Congress is ordinarily willing to have all, or a large share, of the cost borne by the Federal Government. This is the basis for the major reservoir policy under which the Federal Treasury bears all costs allocable to flood control. It is important to note that the reason given for the acceptance of this full responsibility was the impracticability of collecting repayment from all of the vast number of individuals, or the numerous governmental entities, that would be benefited by holding flood waters in major reservoirs. It follows that if it is practicable, in any instance, to arrange for the beneficiaries to assume a share of the cost, then the benefits cannot be considered "widespread and general." It is this reasoning that led to the adoption of the administrative policy that when a reservoir benefits essentially a single community the cost-sharing policy for local protection works will be applied.

2. When Federal construction or financing will give the local interests the benefit of the low interest rate paid by the Federal Government the Congress will usually authorize such construction, or financing, if non-Federal interests will agree to reimburse the Federal Treasury.

3. The Congress accepts the idea that the Federal Government should assume responsibility for accelerating the development of under-developed regions, and will usually authorize Federal assumption of a part of the cost of projects necessary to bring about such acceleration.

4. The Congress will usually authorize the addition of purposes to reservoir projects for navigation, reclamation, or flood control, if it can be made clear that the Federal Government is undertaking the project primarily for one or more of those purposes. This means that Federal agencies should not recommend the authorization of reservoirs primarily for water supply, recreation and similar "incidental" purposes unless they are able to present a convincing argument for Federal assumption of primary responsibility. If, however, non-Federal interests will pay all or a large part of the cost of the "add-ons" the Congress will usually accept the proposal. For example, Congress has authorized reservoir projects primarily for the generation of power because the power revenues are expected to repay the Government for its investment in power. It should also be understood that the trend in Congressional thinking is to expand the field of Federal activities, and that although it may this year refuse to authorize a project primarily for some "incidental" purpose, such as recreation, it may a few years later authorize an essentially similar proposal. The implications of this are clear: the agencies must use good judgment by proceeding slowly and carefully in any attempt to expand Federal responsibilities beyond the bounds set by precedent. It must be remembered that from a purely legalistic standpoint the Congress has accepted only navigation, reclamation and flood control as full-fledged Federal functions. Of course, the time may come - and that in the not too

distant future - when recreation, water supply and similar purposes will be given the same status as the three accepted functions, but Congress does not move rapidly in taking such fundamental steps.

5. If it can be shown that the task clearly transcends the capability of lower levels of government the Congress will usually authorize it to be undertaken by the Federal Government. This was an important factor in convincing the Congress that the Federal Government should assume responsibility for the control of Mississippi River floods.

6. Congress will also be sympathetic to undertaking any project so large or complicated that effective coordination of the plans of several States, or a number of other governmental agencies, would not be practicable. This factor also figured in Federal acceptance of responsibility for flood control on the Mississippi.

Exceptions

Upon occasion the Congress will authorize Federal agencies to carry out projects or programs for which, under the principles outlined above, the primary responsibility should clearly rest with a non-Federal entity. This, of course, is a prerogative of the Congress, and as long as Congress assumes the responsibility for such actions the Federal agencies are fully protected. As technical people, and as servants of the general public, the employees of the Federal agencies have fully met their responsibility if they base their recommendations upon sound principles and established precedents, and they cannot be held morally responsible for any purely political resolution the Congress may reach. Political decisions are the business of Congress; they are not a proper responsibility of employees of the Executive Branch of the Government.

Use of Principles

The principles outlined above constitute useful tests for determining the degree of Federal assumption of responsibility that agencies can safely recommend in proposing specific projects for authorization by the Congress. They also can be very useful in interpreting cost-sharing provisions previously authorized, to the extent that latitude is permitted by the authorizing language. More specifically, it will be found of value to ask, for each contemplated division of responsibility, whether or not it is in harmony with the principles outlined.

COST ALLOCATIONS

by
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1. One of the basic concepts of multiple-purpose water resource development projects is that the facilities provided can be jointly used to achieve benefits from more than one purpose. The determination of how the costs of such multiple-use facilities are to be divided among the purposes served is the process termed cost allocation. When only a single function is served, or when no reimbursement is involved there is usually no need for allocating costs.

2. Prior to the advent of power as a purpose of Federal multiple-purpose projects and the establishment of a Federal policy that power costs should be repaid through revenues, the allocation problem was of no particular significance. With continuous broadening of the scope of Federal water resource projects, additional purposes have been added which have introduced additional needs for cost allocations. Under present Federal laws and policies two purposes, power and water supply, are reimbursable, and costs of other purposes such as irrigation and recreation are reimbursable to some extent. In addition, there have been instances where Federal and non-Federal interests have developed projects under some type of partnership arrangement, thus requiring an allocation of the costs of jointly-used facilities.

3. In approaching the subject of cost allocation it should be understood that the problem is, to a large extent, one of judgment, and that philosophical considerations are as much a part of the problem as the economic and engineering aspects. The subject is one which has concerned water resource development agencies for over two decades, and it is still in the developmental process. The fact that opinion weighs heavily in the problem has prompted the suggestion of many methods of allocating costs, and it was not until the Separable Costs-Remaining Benefits method was proposed in May 1950 by the Subcommittee on Benefits and Costs of the Federal Inter-Agency River Basin Committee that any method of allocation gained widespread acceptance. Many methods had been considered prior to that time; such as the alternative justifiable expenditure, priority of use, incremental, separate projects, benefits and other procedures. Costs of the Bonneville project were allocated on the basis of each purpose carrying its specific cost and the remaining joint-use cost being divided equally between the primary purposes of the project, which were power and navigation. The Wolf Creek, Center Hill and Dale Hollow project costs were allocated by a modification of the alternative justifiable expenditure method previously used by TVA. Since the issuance of the report of the Subcommittee on Benefits and Costs, however, allocation procedures have become more standardized.

4. The Separable Cost-Remaining Benefits method proposed by the ubcommittee, and the principles established in its report, generally eferred to as the "Green Book", were supplemented and expanded by the 2 March 1954 inter-agency agreement among the Departments of Army and nterior and the Federal Power Commission. In that agreement, the rinciples of allocation expressed in the Green Book were adopted, and hree methods of allocation were recognized as acceptable; the eparable Costs-Remaining Benefits, the Alternative Justifiable Expenditure, nd the Use of Facilities methods. The Separable Costs-Remaining Benefits rocedure was recognized as being preferable for general use, and most llocations for large multiple-purpose projects involving power have ollowed that procedure. Norfork and Denison, both dual purpose flood ontrol and power projects located in the southwest, have been notable xceptions. Power was allocated only the incremental cost of adding he power purpose on the basis of legislative history of those two rojects. For projects without power where water supply has been a urpose a modification of the Use of Facilities Method has been used n many instances.

5. With the adoption in May 1962 of the new Presidential standards or project formulation, it became apparent that substantial changes ould have to be made in allocation practices to maintain consistency ith the new procedures. Prior to the adoption of the new standards, ost allocations had largely been restricted to those purposes which ongress had accepted as Federal responsibilities, and to other purposes or which the Government would be reimbursed. The new Presidential tandards for formulation broadened the scope of purposes to be onsidered. Annual charges for taxes foregone which had previously een included in economic analyses were excluded in these new standards. he permissible period of economic analysis was extended from 50 to 100 ears. These changes have had to be reflected in cost allocation ractices to insure a rational and workable distribution of costs that ill be consistent with project formulation.

6. As methods of economic evaluation and formulation have been nder more or less continuous study and improvement, so have methods nd principles of cost allocations. If we are to improve and work toward me degree of perfection in cost allocations, it is necessary that we ntinuously evaluate our experience and try to see where improvements an be made. It would be well to note that the Separable Costs-emaining Benefits method of allocation has had a far greater degree of idespread acceptability and has produced more usable results than any ther method of allocation yet proposed. The method is not perfect, owever, as no method of allocation can be. Some 13 years of experience n applying the method in actual cases has provided much opportunity to bserve its short-comings as well as its merits. Let us proceed, then, o identify those factors which appear to have become generally recognized s acceptable; and then examine those areas where difficulties have een encountered, which may indicate possibilities for improvements.

7. The three basic principles of equity to be observed in cost allocations, as outlined in the Green Book, appear to have stood the test of time very well. This would indicate that these principles are as sound and firm a basis as anything can be expected to be in a subject such as cost allocations, and that they should be carried forward into the future. These three principles are: (1) No purpose should be allocated costs in excess of the benefits from that purpose, (2) Each purpose should carry as a minimum its separable cost, or the cost made necessary by the inclusion of the purpose in the project, and (3) Within the foregoing limits all purposes should share equitably in the savings of multiple-purpose development. Perhaps it would be well, however, to add an additional principle to reflect the new Presidential standards for formulation; namely, that all purposes for which a project is purposely designed should carry an appropriate portion of the cost.

8. Since the procedure followed in the Separable Costs-Remaining Benefits method is essentially a direct application of the basic principles expressed in the Green Book, it would seem logical that the general procedure, too, is sound. This appears to be borne out by the fact that most of the difficulties encountered have not reflected on the propriety of the method, but rather as to how the basic data to be used in the method are to be determined.

9. The problems most frequently encountered in allocations have to do with the benefits, alternative costs, and separable costs used in the Separable Costs-Remaining Benefits method. There has also been a substantial question raised as to the propriety of writing off separable costs on a one-to-one basis. These problem areas are discussed in the following subparagraphs.

a. Benefits:

(1) It would appear that, if benefits are to be used as a basis for distributing costs among various purposes, the benefit estimates should be prepared on as consistent a basis as possible for all purposes to receive equal consideration. As a practical matter, however, benefits are difficult of evaluation and different methods are employed to arrive at estimates for various project purposes. Power benefits are normally evaluated as the cost of the most economical alternative. For flood control, estimates of damages prevented and net land enhancement resulting from reduction of flood hazards are used. For navigation, savings in cost of transportation over alternative means provides the usual basis of evaluation, and for recreation a somewhat empirical unit value for visitor-day use is employed.

(2) The degree of consistency that is achieved in aluating benefits by different means is difficult to judge. However, me idea of the problem can be obtained by comparing estimates of wer and flood control benefits. It is recognized that power benefits many instances do not reflect the maximum amount that users would willing to pay when such benefits are evaluated on the basis of ternative costs. On the other hand, the damage component of flood ntrol benefits is a rather finite amount, as to some extent is land hancement. Thus the question arises as to whether it is equitable allocate costs to flood control on the basis of a benefit estimate ich approaches maximum value as compared to assigning costs to power the basis of estimates recognized to be conservative. There seems be no fully rational solution to this problem at the present time.

(3) Another difficulty arises in the use of benefits as a sis for allocation by the way in which associated costs are handled. example of this is in an allocation which was made for a group of ojects in which all of the four principal purposes, flood control, power, vigation and irrigation, had associated costs. In the case of power, tensive transmission lines were necessary to deliver the power to load nters. In determining the benefits credited to the projects, all cremental transmission costs were, in effect, subtracted from the nefit at the load center. Flood control benefits resulted from a mbination of levees and reservoirs, and the benefits were divided tween the reservoirs and associated works by a rational method. In e case of navigation, benefits were divided equally between reservoirs d associated channel improvements. In evaluating the irrigation function, condary benefits were used. These distributions of benefits between the servoirs and associated features were made for what were considered to good and sufficient reasons, but there is room for question as to eir validity when used as a basis for dividing multiple-purpose costs.

(4) Frequently the recipient of a benefit can place a very al value on the services rendered to him in terms of his own financing sts. Thus, a private power company receiving benefits from an upstream deral storage facility can readily evaluate the benefit to the company terms of its own privately financed alternative generation. Consider e case, however, where the downstream plant might be owned by a rural ectric cooperative which would have a different rate of financing and nsequently different benefits. The question then arises whether it is uitable to assign more costs to a private entity than to an REA operative solely on the basis of the respective financing costs of each.

b. Alternatives:

(1) Perhaps more questions which defy a completely tisfactory answer are raised in connection with alternative costs an any other factor in cost allocations. These questions are compounded the fact that alternatives are used for three different purposes in

cost allocations; (a) in determining benefits; (b) for use in line 2 of the SC-RB procedure as a limit on benefits; and (c) in determining separable costs. A complete dissertation to cover all of the many points that have been raised on alternatives is far beyond the space and time that can be allotted to this discussion, but among the principal questions that have been raised are the following:

(a) Should an alternative be limited to an at-site project, or is an off-site alternative suitable?

(b) Should alternatives be limited to water resource development projects, or can any available alternative which would generate the same product or provide the same benefits be suitable? As an example, should a steam plant be used in line 2 of the SC-RB procedure, or are we limited to a hydro development?

(c) Does the alternative have to be real and probable of construction or can it be evaluated on a hypothetical basis? It has been argued that no alternative is acceptable if it would pre-empt the project site for multiple use.

(d) Can a thermal electric power plant financed at the same interest rate as used for the multiple-purpose project be employed as an alternative for the power feature disregarding the fact that the Federal Government does not normally construct steam plants.

(e) Also, a question which repeatedly occurs is whether the financing and other factors used to evaluate the cost of the alternative should be those applicable to a participant if other than the Federal Government. This matter has been of much concern in evaluating the Federal contribution to flood control in non-Federal projects.

(2) The preceding list is by no means exhaustive of the many questions and variations which have been considered, but is indicative of problems which must be resolved primarily on the basis of philosophy. In developing allocations for Corps of Engineers projects, we have accepted the alternatives normally employed in evaluating benefits for project formulation for use in line 1 of the SC-RB method. This has the value of being consistent with the project formulation, but is open to a question of comparability as discussed in the foregoing. Practices in selecting alternatives to be used in line 2 of the allocation procedure have not been standardized, but in the past the Green Book concept of what would most likely develop in the absence of the Federal multiple-purpose project has generally been followed.

(3) The broad concepts of the new Presidential standards have necessitated further consideration of alternatives, and it appears that changes in our past practices must be made to maintain allocations on a consistent basis with current standards of project formulation.

As discussed later in this paper, we are now thinking in terms of the use of resources (land, labor and material) for alternative projects (line 2 of the allocation) as compared to the resources required to include such purposes in the multiple-purpose projects. Direct comparison is possible only if there is interest and tax equivalence for the various estimates. We are also thinking more and more in terms of the most efficient use of resources, without legal or financial constraints, which means that alternatives need not develop in the absence of the Federal multiple-purpose project. This approach also avoids complicated questions involving the priority of use of potential sites and simplifies the choice of alternatives for the various purposes.

c. Separable Costs:

(1) The Green Book defines separable costs as the difference between the cost of the multiple-purpose project and the cost of the project with the purpose omitted. However, suppose that the purposes of a project with the power function omitted can be achieved at less cost, say, by a group of single purpose projects such as flood control levees, water supply wells, and a water quality control reservoir, than by a reservoir to serve these three purposes at the multiple-purpose project site. Use of these alternatives, or other combinations, rather than the at-site project would increase the separable costs. We are currently giving consideration to this problem in terms of efficiencies in the use of resources (land, labor and materials). The efficiency concept as applied to separable costs would not necessarily mean the same project without the function as in the Green Book concept. Whatever judgments are made in this regard in formulating projects will need to be carried over to the cost allocation to insure the commitment of the same resources to each purpose as used in deciding that the purposes should be included in the project.

(2) The Green Book also introduced the concept of dual separable costs and indicated a procedure for handling certain facilities which are useful for some but not all project purposes. With the advent of the new Presidential standards we are obliged to consider expanding the dual-cost concept to one of multiple separable costs. While this problem has presented itself in the past, it has never been of as serious proportions as it now becomes with truly comprehensive planning for all project purposes. To illustrate, in many instances the separable costs which are incurred to include power in a project also provide storage from which fish and wildlife, recreation, navigation, and other benefits are obtained. If a multiple separable cost concept is adopted, what heretofore has been considered a separable power cost would be divided among a number of project purposes. If, on the other hand, we proceed to a strict interpretation of separable costs as being only those necessary to add a single purpose, then costs for power storage will become joint costs chargeable to all project purposes.

(3) In addition to the problems which are associated with determining basic data for allocations, there is also a significant question that has been raised in regard to the separable costs-remaining benefits procedure. This has to do with the offsetting of separable costs on a one-to-one basis in the procedure now followed. Power interests, who are normally required to carry a large separable cost, have pointed out that as a result of this practice the reduction in the benefit to cost ratio as between the alternative cost and the allocated cost is invariably the greatest for the power function. They can also contend that separable power costs are as essential to the total multiple purpose development as are joint costs, and are therefore entitled to recognition in distributing savings of multiple purpose construction. On the other hand, proponents of purposes with small separable costs can contend with equal validity that they should in no way be required to share in costs expended solely for other purposes. Here again, as in the case of many questions posed in connection with evaluating basic data, there is essentially no completely logical and convincing choice. It is a problem which lies in the realm of judgment or opinion.

10. The fact that problems arise in applying the Separable Costs-Remaining Benefits method, and the necessity of pure judgment decisions in their solution, is not intended to imply that the basic method is not acceptable. Difficulties of application are inherent in any method. Furthermore, the various agencies concerned with cost allocation have been able to recognize the nature of the problems and to agree upon an acceptable solution in a large majority of cases that have arisen.

11. The Presidential Directive of 15 May 1962 left for later consideration details of policy, standards and procedures relating to cost allocation. Nevertheless, it did provide certain general guidelines which are summarized as follows:

a. All purposes shall be treated comparably, and each is entitled to its fair share of the advantages resulting from a project.

b. Costs are to be allocated on a par among all project purposes including, but not limited to, water supply, irrigation, water quality control, navigation, power, flood control, land and beach stabilization, drainage, recreation, fish and wildlife, and under certain circumstances to other purposes such as area redevelopment, servicing of treaties and national defense.

c. Allocations shall be without restriction regarding reimbursement or cost sharing policies.

12. Corps of Engineers standards have already been expanded to include consideration of all purposes for which a project is purposely formulated, which will bring this point in line with the Presidential Directive.

requirement that allocations be made without restrictions regarding
oursement or cost sharing policies encourages objectivity in the
allocation process by not requiring consideration at the same time
he different financial factors which may be involved. This criterion
specially significant in considering partnership projects, such as
e being constructed by others in California (Oroville, Mokelumne,
ed), which involve a Federal contribution for flood control.

13. The requirement of comparable treatment in cost allocations is
flection of concepts of project formulation expressed in the
idential Directive. The intent of the new standards of formulation
o obtain truly comprehensive plans in which all purposes and
rnatives are measured in terms of their true economic worth. To
mplish this, project formulation is based on a relationship of goods
services to requirements and objectives. Specifically, these new
edures exclude those factors which are not pertinent to true
omic comparisons and evaluations, such as those relating to financing,
sharing and subsidy policies. These same principles should be
ied over into the cost allocations which means that, insofar as
ible, all project and alternative costs will be measured on a
arable basis with regard to interest rates, tax considerations,
other factors.

14. It is anticipated that the Presidential Directive of 15 May 1962
be expanded at some time in the future to cover the application
resent concepts to cost allocations, and practices of the Corps of
neers are now being reviewed in connection with the Corps'
icipation in the formulation of the new standards. This review
failed to reveal any reason why the Separable Costs-Remaining
fits method should not be continued, although certain changes in
edure are indicated. Some of these changes have already been placed
effect. Costs are allocated to all purposes for which a project
urposely formulated, and taxes foregone have been eliminated as an
ent of cost. To reflect the concepts of comparability, consideration
eing given to the desirability of evaluating alternatives used in
2 of the SC-RB procedure on the basis of resource values. Under
concept, all such alternatives would be evaluated using the same
rest and other economic factors used in project formulation. Purely
ncial considerations would be eliminated. In addition to achieving
ormity with standards of formulation, use of the resource value
pt will at the same time greatly reduce what has heretofore been
principal problem area in applying the SC-RB procedure.

THE FEDERAL INTEREST IN COST APPORTIONMENT

(Prepared by Berard J. Witzig, Office, Chief of Engineers)

1. Cost apportionment in comprehensive river basin planning. Cost apportionment or cost sharing is the means of achieving the long term objectives of comprehensive river basin planning, by equitably assigning the financial burdens to the different agencies and levels of government concerned with the use of the plans and projects involved. This must largely be achieved within the present framework of existing laws and administrative interpretations. The laws and policies applicable now to individual projects also apply on the whole to systems of projects and complete river basin plans. The existence of inconsistencies in laws and policies which have evolved over a number of years sometimes result in some difficulty in application. Further problems of consistent and equitable cost-sharing can be expected in the broader gauge, longer range planning for comprehensive development of river basins. When these arise, suitable reconciliation or adjustment appears to be proper. Reporting officers should consult with the Office, Chief of Engineers, on such problems as early as practicable. Depending on the situation, inter-agency agreements, specific proposals for local cooperation for consideration by Congress, or proposals for modifications in general law may be in order.

2. Purpose of paper. This paper summarizes, for convenient reference, the legislative and administrative policies which provide the bases for the detailed cost apportionment formulas of the Corps of Engineers, for determining the equitable and legally required sharing of project costs between the Federal Government and local interests. References are given below to the laws, and in Attachment 1 to published regulations for more detailed statements. (Attachment 1 is page 452.)

3. Definition of "cost apportionment." The term "cost apportionment" should be understood and used to mean the division or sharing of project costs among the various users, interests and agencies, that will pay for the project. For our purpose, it is convenient and desirable to restrict the term "cost allocation" to mean only the distribution of total project costs among the project purposes. The costs of each function to be shared will be computed preferably by the separable costs-remaining benefits method of cost allocation.

4. Relation of cost allocation and apportionment to project rmulation and evaluation. Cost allocation and apportionment have relation or effect on project formulation and evaluation. The solute economic merit of a project depends only on the relation of onomic costs and benefits and not on who should pay for the costs or o receives the benefits. The separable costs alone determine the onomic justification of including a specific purpose in a multiple-rpose project; the objective of evaluation is to test economic ficiency. Cost allocation is only to distribute costs among functions, d cost apportionment is only to distribute allocated costs among benefi-aries or users; the objective of cost-apportionment is to secure uitable cost-sharing or to achieve defined legal goals of income distribution, area redevelopment, etc. However, cost sharing affects d is affected by financial feasibility. A project may be economically stified because benefits exceed costs to the general economy but may t be financially feasible because the parties who should bear the located costs are unable or unwilling to carry their fair share of e burden.

5. Administrative interpretations. In general the policies defined law for authorized projects and by past administrative decisions are apted and applied in survey investigations of similar new projects ing considered for Federal authorization. The proposed applications come the law for the specific projects involved when, and if, the pro-cts are authorized by Congress. If the authorizing act or the project cument is not specific, the general policies then apply. It is the licy of the Chief of Engineers to apply the specific provisions of cal cooperation stated in the project document to projects authorized Congress, regardless of subsequent changes in general law. Inclusion the word "estimated" in qualification of monetary shares is construed mean that the final adjustment of Federal and local shares of project sts will be recomputed using the report procedures based on actual sts incurred when the project is undertaken and completed. Omission the word "estimated" means that the percentage or amounts stated are be applied without change or adjustment. It is now customary to phasize in reports that all cost-sharing is in terms of estimated ounts for future recomputation, except for percentages fixed by law.

6. Application to basin studies. In future studies, including mprehensive river basin planning, reporting officers should assume at the policies and procedures given in law, and in the manuals and gulations of the Chief of Engineers, will be used in recommending fair d equitable sharing of costs for proposed projects. It is expected, wever, that problems of cost-sharing will arise as a result of inter-ency coordination and that consideration will have to be given to me correlation of cost-sharing policies on projects of common interest. some cases, prevailing standards of cost-sharing for projects under udy or not completed may differ from those current at the time of oject authorization. Sound long-range basin plans may also contemplate.

changes in projedt use or function and, therefore, may affect decisions of equity in cost-sharing. In such cases, it may be necessary to recompute Federal and local cost-sharing, and to consider the desirability of recommending changes in local cooperation for new basin plans or projects. All such problems should be anticipated as far in advance as possible, and referred to the Office, Chief of Engineers for advice. All reports and studies should summarize and discuss the applicable laws and policies, and give separate breakdowns of proposed sharing of both construction and operation, maintenance and major replacement costs among the Federal agencies and local interests involved.

7. Bases for cost apportionment policies. Sharing of costs of water resource projects under the jurisdiction of the Chief of Engineers between Federal and non-Federal interests are based on:

a. Federal river and harbor, flood control, water supply, and related laws affecting water resources development;

b. The local cooperation requirements of the Acts authorizing the projects;

c. The current administrative guidance issued by the Chief of Engineers.

8. General principles underlying the Federal interest

a. The Constitutional basis. The Federal interest in the investigation and development of projects for navigation began with legislative and administrative interpretation of the Commerce clause of the Constitution, which provides that Congress shall have power "to regulate commerce with foreign nations, and among the several States, and with the Indian tribes." Other matters affecting the general welfare and commerce in a broad sense, such as flood control, have been given legislative consideration over the years as the economy of the Nation grew more complex and the interrelations of water uses were recognized.

b. The legislative basis. Various Acts of Congress, starting with the Act of May 24, 1824, and continuing through the "Omnibus" Act of 1962 defined the chief Federal interests in assuming part or all of the costs of certain aspects of water resources developments for drainage, water supply, fish and wildlife conservation and enhancement, pollution abatement, recreation, and shore and beach protection, as well as the older Federal interests in navigation, flood control, and irrigation.

c. The equity basis. Where the Federal interest has been by Congress, cost-sharing determination must adhere to the specific cost-sharing policies in the law. Where these are not specifically defined, it is the policy of the Chief of Engineers to apply or adopt precedent determinations of similar type, and also to respond to Section 2 of the 1920 River and Harbor Act, which states in part that: . . . "... Every report submitted to Congress in pursuance of this section or of any provision of law for a survey hereafter enacted, in addition to other information which the Congress has heretofore directed shall be given, shall contain a statement of special or local benefit which will accrue to localities affected by such improvement and a statement of general or national benefits, with recommendations as to what local cooperation should be required, if any, on account of such special or local benefit . . ." The regulations and manuals of the Chief of Engineers attempt to provide policy positions for equitable cost-sharing consistent with law and procedure.

9. Major laws affecting cost apportionment. The following citations illustrate the growth and trend of Federal interest in participating in the costs of water resource developments. More complete statements are contained in the pamphlet, "Laws and Procedures Governing Conduct of the Civil Works Program," issued by the Office, Chief of Engineers in April 1959.

Act	Effect on cost apportionment
3 March 1909	Required reports to give increased detail on basis of Federal participation
1 March 1917	a. Adopted Federal flood control project for the Sacramento River and the Mississippi Valley.
	b. Applied all existing laws to flood control.
	c. Prescribed that all flood control surveys should include comprehensive study of watersheds, including consideration of water power and other uses.

5 June 1920	Required Chief of Engineers to include in survey reports recommendations for special local cooperation when any special benefits would accrue (Sec. 2).
3 March 1925	Authorized estimate of surveys required of navigable streams of U.S. for formulation of general plans for navigation, water power, flood control and irrigation (and resulted in H. Doc. 308, 69th Congress.)
21 Jan 1927) 15 May 1928)	Authorized the "308" studies, which provided Congress with basis for the emergency relief projects of the 1930's and the basic plan of the TVA.
15 May 1928	Sec. 2 defined the general policy of requiring local cooperation toward flood control work.
10 Feb 1932	The "Fletcher" Act enlarged the Federal interest in navigation to include small craft.
22 June 1936) 28 June 1938) 18 Aug 1941)	The Flood Control Act of 1936 declared flood control a proper Federal activity, and defined the "a-b-c" provisions of local cooperation. (See para 12-13, below.)
28 June 1938	Authorized provision of facilities in dams authorized in the Act to permit possible future use for power.
21 June 1940) 16 July 1952)	The bridge Act of 1940 as amended by that of 1952 provided for Federal assumption of costs of replacing railroad and highway bridges obstructive to navigation; costs of betterments in such replacements are the owners.
22 Dec 1944	Recognized rights of States in water resource development; provided for consideration of major drainage improvements in flood control surveys; authorized provision of facilities for public recreation and for conservation of fish and wildlife; provided for disposal of surplus electric power and surplus water.
24 July 1946	Authorized Federal provision of relocations of railroad bridges and approaches required by local protection projects.

Aug 1946) July 1956) Oct 1962)	Beach and shore protection became Federal activities, with the 1962 River and Harbor Act providing for Federal assumption up to 50% of the construction costs of protecting publicly owned or used lands, and up to 70% in park and conservation areas.
Aug 1946) Aug 1958)	Fish and Wildlife Coordination Acts provide for remedy of damages from projects, and for preservation and enhancement of fish and wildlife, with Federal assumption or participation in costs.
July 1958	Title II (Flood Control) authorized hurricane flood protection projects with Federal participation up to 70% of costs.
July 1958	Title III (Water Supply) clarified requirements for repayment for water supply, project modifications therefor, and inclusion in projects of provisions for future water supply with repayment. (See para 18-19, below.)
July 1960	Authorized certain local protection projects with requirement of at least 20 percent local contribution, including lands, etc.
June 1961	Title VII of the Housing Act of 1961 provides for grants up to 20 to 30% for acquisition of open land (as in flood plains) for parks, etc.
July 1961	Water quality control by reservoir storage was defined as a non-reimbursable cost if the benefits are widespread or national in scope. (See para 20.)

10. Commercial navigation. The commerce clause of the Constitution d the body of law subsequently enacted have resulted in a generally well fined area of Federal interest in undertaking improvements for commer- al navigation. The construction costs of commercial navigation projects, cause of the general or widespread nature of their benefits, are borne ost entirely by the Federal Government. As a general rule, however, al interests are required to provide terminal facilities, dredging in rthing areas, and the necessary lands, easements, rights-of-way and spoil sposal areas (where available) with retaining dikes therefor. They are

also required to alter utilities such as pipelines and sewer outlets which may be affected by the projects. Navigation improvements are maintained and operated by the Federal Government. Section 2 of the River and Harbor Act of 1920 provides that survey reports shall determine special and general benefits of navigation projects, and shall recommend any additional local cooperation to be required because of special benefits. Among these are betterments in bridge changes, and land enhancement from disposal of spoil dredged from project areas. The Bridge Act of 21 June 1940 as amended by that of 16 July 1952 provided for Federal assumption of costs of replacing railroad and highway bridges obstructive to navigation, with the owners to assume the costs of any betterments and benefits accruing to themselves.

11. Recreational navigation. The Act of 10 February 1932, generally known as the "Fletcher Act," enlarged the scope of the Federal interest in navigation to include in "commerce" the use of waterways by "seasonal passenger craft, yachts, houseboats, fishing boats, motor boats, and other seasonal water craft, whether or not operated for hire." The special nature of recreational benefits to individuals has resulted in the present basis for Federal and local cost-sharing in recreational small boat harbor projects which provides that the Federal Government participate to not more than 50 percent of the costs of general navigation facilities serving recreational traffic. Local interests are required to provide all lands, easements, rights-of-way, a public wharf open to all on equal terms, and all servicing and self-liquidating facilities, including dredging in berthing areas, and necessary policing and other services. The Federal Government assumes pre-authorization survey costs, and the total costs of navigation aids and of maintenance for the general navigation facilities. The general navigation facilities are defined as including a safe entrance channel, protected by breakwaters or jetties if needed, protected anchorage basins, and major interior access channels and turning basins. Minor access channels adequate for maneuvering into the berths, stalls or slips are provided locally. Berthing areas, docks, landings, berths, stalls, slips, and mooring areas used for marina-type facilities, are provided and maintained at non-Federal expense.

12. Flood control. The Act of 1 March 1917 provided that all existing laws on reports and projects for rivers and harbors should also apply, in so far as practicable, to flood control, including comprehensive study of watersheds. The Flood Control Act of 22 June 1936 established the first nationwide flood control policy. Declaring that flood control is a proper Federal activity, it provided that the Federal Government should improve or participate in improvements of navigable waters or their tributaries for flood control "if the benefits to whomsoever they may accrue are in excess of the estimated costs, and the lives and social security of people are otherwise adversely affected." This act also stipulated for the projects authorized therein what have become known as the "a-b-c"

al cooperation. The general Federal policy on local flood control, repeated in each of the authorization Acts so, provides that construction of local protection projects shall not be undertaken until States, political subdivisions thereof, or other responsible local agencies have given assurances satisfactory to the Secretary of the Army that they will (a) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project, except as otherwise provided herein; (b) hold and save the United States free from damages due to the construction works; (c) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army. The Flood Control Acts of 1938 and 1941 modified this policy by requiring the a-b-c requirements only for channel and local protection projects and not for flood control reservoirs. This modified policy is now commonly applied in Corps of Engineers' practice. In addition, provision of requisite lands is considered to include, and reports should determine and specify, particular relocations to be provided by local interests. The Flood Control Act of 24 July 1946 authorized the Chief of Engineers to include at Federal expense necessary railroad bridge alterations in authorized flood protection projects.

13. Small flood control reservoirs. The part of reservoir costs allocated to flood control is generally distributed between Federal and local interests in the same way for small as for large reservoirs, except that when the small reservoirs serve in lieu of other types of local protection measures, or the benefits are concentrated in one locality, or the reservoirs are limited in size and effect, special local cooperation may be in order. As discussed in the Engineering Manual, special considerati may indicate that maintenance, operation and major replacements be done by the Federal Government with reimbursement of the costs thereof by local interests. These considerations may be particularly pertinent in river basin plans when both large and small reservoirs may be involved. When the interests of the Corps of Engineers overlap with those of the Department of Agriculture and the Department of Interior, small reservoir plans should be reported upon in accordance with Executive Order No. 10913, 18 Jan 61 (App F of EM 1120-2-101).

14. Major drainage. The Flood Control Act of 22 December 1944 provided for consideration of major drainage as an aspect of flood control. Corps policy on Federal participation in major drainage outlets is based on flood control law, the aspects of special local benefits from such works, and the similarity of improved land income and values from drainage to those from reclamation by irrigation. Construction costs, including lands, allocated to major drainage are shared on a 50-50 basis, with local interests required generally to contribute their share in cash or equivalent work, as well as providing the rest of the usual "a-b-c" provisions of local cooperation. The "50-50" formula was adopted administratively by the Chief of Engineers on the basis that cost-sharing in a degree equivalent to that in irrigation projects is fair and equitable. Under irrigation law, water users repay the full construction costs without interest,

and this, over a 40 to 50-year period is closely equivalent to about half the economic costs including interest.

15. Irrigation. When irrigation in the 17 western states is a project function, costs are allocated thereto using benefit estimates, including acceptable secondary benefits, provided by the Bureau of Reclamation, and modified if necessary, by reporting offices to conform to Corps' practice. Repayment by the water users is normally arranged for by the Bureau of Reclamation in accordance with Reclamation Law and the specific provisions of project authorization.

16. Hurricane, tidal and lake flood protection. The Flood Control Act of 1958 authorized several hurricane flood protection projects, with the Federal Government to bear 70 percent, and local interests to bear 30 percent of the total first costs of projects for this purpose. The total first costs for cost-sharing include all construction, lands, easements, rights-of-way, and relocations. When the normal basic land requirements of flood control law amount to less than 30 percent of total first costs, the difference is required of local interests as a cash contribution; when they exceed 30 percent, they become the minimum requirements. Depending on the nature of the works involved, part or all of certain items of operation and maintenance, which would normally be borne by local interests, may preferably be performed by the Federal Government (such as operation of navigation gates in hurricane barriers). In such cases, local interests, may be required to contribute additional costs equivalent to their responsibility for future operation and maintenance costs.

17. Hydroelectric power. The Flood Control Act of 1 March 1917 required that all flood control surveys include consideration of water power. The Flood Control Act of 28 June 1938 authorized provision of facilities in dams authorized in the Act to permit possible future use of power. The Flood Control Act of 22 December 1944 provided for disposal of surplus electric power. When power is an economically justified function in a reservoir project of the Corps of Engineers and is authorized by Congress, the costs properly allocable thereto are determined by the Chief of Engineers and assigned to the beneficiaries through the medium of the rates for sale of power set by the Federal power-marketing agencies with the approval of the Federal Power Commission. The marketing agencies of the Department of the Interior and the Tennessee Valley Authority are consulted on the marketability of project power during investigations. The part of the costs so paid are returned to the Federal Treasury.

18. Water supply storage. Where storage for municipal and industrial water supply is made available by multiple-purpose projects, water users are required to pay the cost allocated to such storage. Under the River and Harbor Act of 1944, the Secretary of the Army is authorized to dispose

"surplus" water for domestic and industrial uses at such prices and
ms as he may deem reasonable. The Water Supply Act of 1958 (Title III,
lic Law 85-500), as amended, provided additional authority to the Corps
Engineers to include municipal and industrial water supply storage for
ediate and anticipated future demand in any reservoir project surveyed,
nned, constructed, or to be planned, surveyed, and/or constructed by the
ps of Engineers, provided State or local interests contract or give
surances that they will contract for the use of such storage on a basis
ch will permit paying out the costs allocated to water supply within
life of the project and within 50 years after the water supply storage
first used. Water supply costs to be repaid by local interests are
sed on the interest rate prescribed by the Secretary of Treasury. Where
ter is not used immediately for water supply, no interest on the invest-
nt is charged until used up to a period of 10 years. Storage for future
ter supply is limited to 30 percent of the total project costs under the
, but larger proportions can be considered in studies and recommended for
thorization.

19. Water conveyance facilities. Need for facilities for withdrawal
water from storage and its conveyance to point of use is considered
survey report studies to the extent necessary for sound planning and eval-
tion of Federal projects involving water supply, storage, to insure
equate consideration of possibilities for multiple-purpose development
which the Federal interest may extend, and to insure effective develop-
nt and use of water resources. Based on discussions with the Bureau of
Budget and the Community Facilities Administration, consideration is
ng given to policies on conveyance facilities generally as outlined in
draft letter, attachment 2, pages 453 through 458.

20. Water quality and pollution control. The Federal Water Pollution
ntrol Act of 1961 (P.L. 87-88) amended P.L. 660-84th Congress to include
orage in Federal projects for regulation of stream flow for water quality
ntrol under certain criteria, with Federal assumption of the costs if
benefits are widespread or national in scope. These conditions,
scussed more fully in EM 1165-2-112, include interstate and geographical
nsiderations, type of pollutants, availability of alternative solutions,
stribution and costs of pollution abatement measures for which stream-
w regulation is a necessary supplement, number and diversity of benefi-
aries, and special Federal interest areas.

21. Outdoor recreation. Section 4 of the Flood Control Act of 1944,
amended prior to 1962, authorized provision of facilities at reservoirs
public recreation and fish and wildlife. Recommendations for Congresional
thorization of projects involving preservation, enhancement, and basic
visions for a full variety of public uses of outdoor recreation resources
matters of Federal interest in water and related land resource develop-
nt, are based on: (a) Provision or participation in the provision of
propriate combinations of lands, structural measures, non-structural
asures, and project operating arrangements for these purposes as elements

of multiple-purpose projects, provided, that the other purposes to be served in themselves afford a functional basis for Federal participation in project development (as in the case of flood control), and the benefits creditable to them are equal to 50 percent or more of total project costs; and (b) Assumption of costs allocated to both general and fish and wildlife recreation, including separable costs, plus joint costs not in excess of 25 percent of total project costs, provided, that non-Federal interests bear remaining costs allocated to recreation. These criteria are the results of administrative study by the Corps of Engineers and experience in the growing interest and demand of the public for outdoor recreational facilities at Corps' projects. As stated, they provide a basis for including provisions for recreation in recommended projects and for Federal and non-Federal participation in the recreational aspects. The amendment in Sec. 207 of the 1962 Flood Control Act extending the 1944 authority as amended to all water resources projects is under study and a revised EM 1120-2-115 will be issued on the matter as soon as possible. In the meantime, the current policies for treatment of different types of recreation projects will be continued. A policy on Federal participation in facilities for sport-fishing from breakwaters is in preparation.

22. Fish and wildlife measures. Facilities for fish and wildlife may fall into two general categories:

a. Measures for remedy of project-caused damages. Remedial measures to prevent or mitigate project-caused damages may be just as much a part of the project as relocation of a highway. They should be incorporated in the project if their costs are less than the damages prevented. These damages, whether evaluated by judgment or by some formula, do not enter into the overall project justification unless the remedial measures are omitted as excessive in cost. When included, the costs of the remedial measures may be apportioned and assigned to the various project functions involved as for the other joint project costs, and borne in an equitable manner by the interests concerned with these functions.

b. Measures for conservation and enhancement. The allocated costs of justified measures for the conservation and enhancement of fish and wildlife may be assigned to the Federal Government when they are parts of a national or basin program for fish and wildlife development in accordance with the Fish and Wildlife Coordination Act of 1958 (P.L. 85-624) as determined by the Federal and State conservation agencies. These matters should be carefully developed during the investigation, and reporting officers should fully present the bases for their recommendations.

23. Cost-sharing under the small project authorities. Under several different laws, Congress has authorized the Secretary of the Army and the Chief of Engineers to authorize small flood control, navigation and shore and beach protection projects up to specified limits of Federal costs, as

ted below. Somewhat larger projects may be authorized and undertaken local interests pay the excess costs over the statutory Federal limit. addition, all the requirements of local cooperation for large projects ally apply to th se projects and are determined in the project studies sidered by the Chief of Engineers in deciding upon authorization.

e of small project	Basic Law	Statutory Limit on Federal Cost
od control	P.L. 685, 84th Cong. as amended by Sec. 205, PL 87-874	$1,000,000
igation	P.L. 86-645 (Sec. 107)	200,000
ch and shore tection	P.L. 87-874 (Sec. 103)	400,000

24. Beach and shore protection. When beach and shore protection functions of a comprehensive river basin plan, the costs allocated reto shall be shared in accordance with the Act of 13 August 1946, amended by Section 103 of the River and Harbor Act of 23 October 1962. ER 1120-2-110.) Federal assumption of costs in shore and beach tection may be recommended in accordance with the following:

	Shore Category (1)	Maximum level of Federal Aid: Construction	Maintenance
I	Federally owned	100%	100%
II	Publicly owned, non-Federal parks and conservation areas	70% (2)	None
III	Publicly owned, non-Federal other than parks and conservation areas	50% (2)	None
IV	Privately owned, where protection will result in public benefits	50% multiplied by the ratio of public benefits along Cat. IV shore to total benefits along Cat. IV shore.	
V	Privately owned, protection will not result in public benefits susceptible of evaluation.	None	None

(1) See ER 1120-2-110, 5 April 1963, for complete criteria.
(2) Cost-sharing percentages do not apply to lands, easements and rights-of-way.

25. "Hold and Save" Provisions. The hold and save clause incorporated in past reports generally had the intention of freeing the United States from claims for damage due to the construction works, when special conditions and possibilities of damages could be foreseen and warranted this provision. Local interests are not expected and should not be required to be responsible for damages resulting from construction operations such as blasting or negligence of the construction contractor. Likewise, local interests cannot be expected and should not be required to hold and save for indefinite periods against unspecified or unpredictable contingencies. A separate letter of explanation should accompany reports, if necessary, setting forth the circumstances for the manner of treatment of this matter in the report, whether the clause is omitted or included.

26. Cash contributions and repayment.

a. Cash contributions. Application of policy will often result in requirements of non-Federal cash contributions. Cash contributions recommended by reporting officers should be expressed in terms of a percentage of the construction cost of the project recommended for authorization, with an indication that the present estimate of the cash contribution as given in the report is for information and is not a fixed dollar amount which non-Federal interests will repay regardless of project changes and price fluctuations when construction is undertaken. A specific percentage stated in the recommendation becomes final after authorization. If a formula is intended to apply, the word "estimated" should qualify the percentage and/or the amount. When impractically high contributions improbable of realization result from these procedures, the results of following the rules should be stated, and sound reasons given for any deviation recommended.

b. Repayment period. In appropriate cases for drainage, water supply and recreation reporting officers may consider arrangements for periodic payment of the non-Federal cash contribution toward the Federal project, with interest, over an appropriate period of years, not to exceed the economic life of the project, or 50 years, whichever is less. Extended payment otherwise has been limited to the construction period. Proposals for periodic payments should be brought to the attention of the Chief of Engineers for consideration prior to the making of any commitment with local or State interests or making a firm recommendation in the survey report.

c. Repayment procedures. When a local contribution toward the cost of the improvement over and above the value of lands, easements, rights-of-way, and relocations is indicated, reporting officers should consider the following means of repayment by local interests in making

their recommendations:

(1) Contribution of the entire amount in cash before any Federal construction starts, or agreement to provide equivalent work in kind applicable to the Federal project, particularly where the necessary Federal funds will probably be provided in one work allowance or the work will be performed under one contract.

(2) Agreement to pay over the period of time in which the project is constructed in the form of a percentage of construction cost, with interest, or to do equivalent work applicable to the Federal project, as a prerequisite for initiation of construction. When construction requires a number of years, provision may be made for a series of local payments to coincide with and be equal to the local share of each contract at the time that the work is advertised, with appropriate adjustment after the contract is awarded. Each contribution should include an appropriate contingency allowance to cover change orders and overruns.

(3) For drainage, water supply and recreation, agreement to repay the required local share of the first cost, including interest during construction, in annual installments with interest on the unpaid balance over a period not to exceed the useful life of the project or 50 years, whichever is less; or agreement to do equivalent work, applicable to the Federal project, partly or wholly in substitution for a cash contribution. If repayment over the project life is proposed or adopted, local interest should be required to enter into a repayment contract.

27. Statement of requirements of local cooperation. The recommendations in favorable reports should clearly state that authorization of improvements is recommended provided that, when relevant, responsible local interests shall give assurances satisfactory to the Chief of Engineers that they will:

a. Provide without cost to the United States all lands, easements, and rights-of-way necessary for construction (and maintenance, when Federal) of the project, except for reservoirs;

b. Provide without cost to the United States all relocations and local betterments required for the project, except as otherwise warranted for special reasons;

c. Hold and save the United States free from damages due to the construction work, when appropriate;

d. Maintain and operate specified project works after completion and other related works, in accordance with regulations prescribed by the Chief of Engineers;

e. Provide a cash contribution expressed in percentage of the estimated Federal cost of construction, the final contribution to be determined when the actual costs are known; or, construct such additional items of work as may be agreed upon by the Federal Government and the local interests;

f. Provide such other measures of local cooperation as determined to be appropriate by the reporting officers.

g. Organize a properly constituted public agency under the laws of the State, to cooperate with the Federal Government, provide the required measures of local cooperation, and provide such associated public works as needed to insure effective use and realization of the benefits of the project.

Include at end of recommendations a statement to the effect that: "The net cost of the recommended project to the United States is estimated to be $(state amount)."

28. Coordination with local interests on cost-sharing requirements. At an early point in investigations, local interests should be informed of the general nature of requirements of local cooperation that may be imposed if Federal projects are found feasible for recommending authorization to Congress. Local interests should also fully understand that they will be expected to proceed with assumed specific associated development upon which project use and design are predicated, in so far as these are practicable and not merely the assumed long-range projections derived from economic base studies for long-term evaluation. Essential to satisfactory cooperation is the willingness and the financial and legal ability of local interests to cooperate with the Federal Government. A local agency properly constituted under State law is also necessary, and it is generally preferable that the Federal Government deal with local agencies through the State Governments. Reports should fully set out these matters, and finally should carefully and clearly state the specific requirements of local cooperation and cost sharing.

Att
1. References, page 452
2. Draft of circular, pages 453-458

COST APPORTIONMENT

REFERENCES

ULATIONS AND MANUALS

1120-2-101, Survey Investigations and Reports, General Procedures
- Sec. V - Navigation
  - Par. - 1-53 - Proposed local cooperation
  - 1-55 - Apportionment of costs among interests
- Sec VI - Flood Control
  - Par. - 1-84 Proposed local cooperation
  - 1-86 Apportionment of costs
- Sec VII- Beach Erosion control
  - Par. - 1-115 - Apportionment of costs
- Sec XI - Coordination with local interests
  - Par. - 1-163 - Local cooperation in project costs
  - 1-164 - Local cooperation in study costs

1120-2-109, Federal Participation in Major Drainage Improvements (See also OCE Position Paper, ENGCW-PD, 21 Mar 62, "Proposed simplified criteria for use in determining scope of project and Federal-local cost-sharing where drainage of wet or otherwise 'Water-damaged' lands is involved.")

1120-2-110, Federal Aid Toward Shore Restoration and Protection, 5 Apr 63

1120-2-113, Benefit-Evaluation and Cost-Sharing for Small Boat Harbor Projects.

1120-2-114, Federal Participation in Projects for Hurricane, Tidal and Lake Flood Protection, and Projects Combining these Purposes with Beach Erosion Control.

1120-2-115, Recreation as a Purpose of Civil Works Projects (as modified by teletype ENGCW-PD No. 170, 23 May 1962 to Division Engineers - see Incl. 4 with multiple letter, ENGCW-PD, 15 June 1962, subject: "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources.")

1145-2-310, Alterations of Obstructive Bridges - Policy, Practices and Procedures

1150-2-301, Local Cooperation, Policies and Procedures

1165-2-103, Construction of Shore Protection Works

1165-2-102, Power in the Navigation and Flood Control Program

1165-2-104, Fish and Wildlife Conservation in Corps of Engineers' Projects

1165-2-105, Water Supply Storage in Corps of Engineers' Projects

1165-2-109, Financial Feasibility of Hydroelectric Power

1165-2-112, Streamflow Regulations for Water Quality Control (Pars. 25-29 (discuss apportionment of costs and local cooperation.)

PRELIMINARY

HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D.C.

ENGCW-PO (July 1963)

SUBJECT: Conveyance Facilities for Municipal and Industrial Water Supply from Corps Projects

TO: Division Engineers, except Division Engineers, MDD and POD
District Engineers, except District Engineers, East Ocean, and Districts in MDD and POD

1. This multiple letter amends and clarifies the policies and procedures set forth in EM 1165-2-105, paragraph 16, relative to the financing and construction of facilities for the withdrawal and conveyance of municipal and industrial water from Corps of Engineers' reservoir projects to point of use.

2. Need for facilities for withdrawal of water from storage and its conveyance to point of use shall be considered in survey report studies to the extent necessary for sound planning and evaluation of Federal projects involving water supply storage, to insure adequate consideration of possibilities for multiple-purpose development to which the Federal interest may extend and to insure effective development and use of water resources, subject to the following:

a. The planning, financing, and construction of facilities for the withdrawal and conveyance of water from Corps of Engineers' reservoirs will normally be considered to be the responsibility of the potential water users, except in the case of water supply outlet works which are an

integral part of the Federal construction work. In this latter case, such outlet works or conduits through the dam will be planned, financed and constructed by the Corps of Engineers and the costs allocated to water supply subject to full reimbursement by the water users in the same manner as for reservoir storage capacity provided for water supply.

b. In accordance with the foregoing, conveyance facilities will normally not be recommended as part of the Federal project but will be left for local interests to provide (see subparagraph f, below).

c. Reporting officers should analyze the local plans for conveyance facilities sufficiently to insure that water provided in a Corps reservoir can be and is likely to be utilized generally in accordance with the projected schedule for future water needs. The local responsibility for providing conveyance facilities, distribution systems, and treatment plants, should be considered when evaluating potential contractual arrangements relative to repayment of the water supply storage costs. Such consideration should also include, insofar as practicable, investigation of the legal and financial ability of the local interests concerned to carry out these responsibilities.

d. If local interests request the Corps of Engineers to provide conveyance facilities as part of the Federal project they should be informed of the Corps' policy as expressed in subparagraphs a and b, above, and should be advised that the Community Facilities Administration, Housing and Home Finance Agency, is the Federal agency which is authorized,

subject to certain requirements, to assist in the financing of these improvements, both planning and construction, if such assistance is needed and sought by the local interests concerned. A listing of the addresses of the Regional Administrators, Housing and Home Finance Agency, is attached.

e. The Regional Administrator, Housing and Home Finance Agency, will be informed at the earliest practicable date of surveys and studies which may involve consideration of withdrawal and conveyance facilities as well as water treatment works and additional local distribution systems needed by others to make use of the water stored in Corps projects. The Regional Administrator should also be informed of any direct request to the Corps of Engineers for assistance and of the Corps' response as discussed in the preceding paragraph. In such referrals, the Administrator should be requested to inform the District Engineer concerned as to whether or not the Community Facilities Administration has jurisdiction in the specific case under consideration.

f. Only under the most exceptional circumstances may facilities for the withdrawal and conveyance of water be considered for inclusion as a part of the project to be authorized for construction by the Corps of Engineers. Such cases may arise when it is clear, after consideration of all normally applicable procedures, that local interests will not be able to accomplish the needed construction alone and have been found by the

Community Facilities Administration not eligible for financial assistance under its programs. Recommendation for authorization for Corps construction of such facilities therefore should be clearly justified by the circumstances. The views of the Regional Administrator should be sought in arriving at a determination in such cases, particularly as to whether or not the Community Facilities Administration considers that recommendation for Federal construction of conveyance facilities as part of the Corps' project is reasonable and advisable, and whether or not it is considered that such assistance is really needed by local interests.

g. If the construction of conveyance facilities is accomplished by the Federal Government, the first costs may be paid at the time of construction with contributed funds or on an annual basis, with interest during construction, beginning at the time of completion of such works. The procedure with respect to the acceptance of contributed funds is set forth in ER 1140-2-301. In the case of payment on an annual basis, repayment arrangements will generally be the same as for water supply storage, except that there should be no deferral of interest charges such as provided by the Water Supply Act for future demand storage. Conveyance facilities constructed by the Federal Government will normally be turned over to the local water users for maintenance and operation.

3. Survey and planning reports will indicate the steps which have been taken to insure that conveyance facilities and other works required

to make use of water supply storage in Corps projects will be available by the time the water is needed.

4. It is requested that Division Engineers arrange for discussions with the Regional Administrators, Housing and Home Finance Agency, with respect to jurisdiction, timing of coordination, authority and procedures of the respective agencies, and possible problem areas.

5. The investigations required by the Community Facilities Administration where Corps construction of conveyance facilities is being considered for recommendation (see subparagraph 2f) may exceed the normal CFA responsibilities and capability under their authorizing legislation. In such cases, District Engineers are authorized to reimburse CFA for the cost of investigations required to determine whether Corps assistance to local interests is justifiable. (This matter is to be discussed further with CFA, and a memorandum of understanding sought, before final issuance of the multiple letter. In the meantime, refer any problems to OCE).

6. The foregoing policies and procedures are effective immediately; change to EM 1165-2-105 will be issued as soon as possible.

1 Incl
List of Regional Offices,
Housing & Home Finance
Agency

710-215 O-63-30

HOUSING AND HOME FINANCE AGENCY

Regional Offices

Region	Regional Administrator	Address
I	Lester Eisner, Jr.	Room 906, 346 Broadway New York 13, New York
II	Warren P. Phelan	Room 1004, Widsner Bldg. Chestnut and Juniper St. Philadelphia 7, Pa.
II	McClellan Ratchford	Room 645 Peachtree-Seventh Bldg. Atlanta 23, Ga.
IV	John P. McCollun	Room 1500 360 North Michigan Avenue Chicago 1, Ill.
V	Roderick A. Bethune	Room 2000 Federal Center 300 West Vickery Blvd. Fort Worth 4, Tex.
VI	John G. Melville	3rd Floor 989 Market Street San Francisco 3, Calif.
	also - Lindley R. Darkee Director Northwest Operations	909 First Avenue Seattle, Washington
II	Elisco G. Foat	P. O. Box 9093 1608 Ponce de Leon Ave. Santauree 17, P. E.

COORDINATION PROCEDURES

by

Burnham H. Dodge
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North Atlantic Division

and

Charles A. Cocks
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Summary

Discusses the meaning and the substance rather than the form of coordination in water resources planning. Points out the need for organized effort to improve communication with the public.

1. In the early investigation stages of water resources many years ago most of the planning was for single purposes. What went on between authorization for a study and an initial public hearing and submission of the final report to the Congress was considered to be of little or no concern to anyone outside the Corps. This resulted in part from a general absence of public interest in details and from a concept that the Corps report was semi-confidential until released by Congress.

2. As planning became more sophisticated and multipurpose projects became more numerous public awareness and interest also increased. Paralleling this trend was a growing responsibility in related fields assigned by law to many other Federal agencies. Finally there followed clear indications from the Congress that differences between Federal agencies and with non-Federal interests should be resolved if possible before a report is submitted rather than after. All of this results in some degree of coordination now being an essential element in all investigations.

3. So far as basin studies are concerned it may fairly be said that water resource planning has reached the "Gold-fish Bowl" stage. The work is now carried out in plain view - on the front counter so to speak - where just about anyone with a legitimate interest may observe, comment, and participate.

4. There has been a substantial number of coordination efforts in the field of water resource planning in which the Corps has played an important or leading role:

a. The several Inter-Agency River Basin Committees established for major river basins by secretarial agreement and later continued as Inter-Agency Committees on Water Resources under Presidential Directive. These have operated in western and mid-western river basins. The Federal agencies have equal responsibilities and probably exert influence in proportion to the extent of their going programs. States are also members of the Committees.

b. The New England-New York Inter-Agency Committee (NENYIAC) which produced the NENYIAC report.

c. The Northeast Resources Committee which succeeded NENYIAC after completion of that report to continue the coordination.

d. The study Commissions of Texas and the Southeastern United States. These like NENYIAC have concentrated on identification and evaluation of the water resources, leaving to later study the development of specific projects and their justification. These Commissions were given broad responsibilities and transcend departmental lines.

e. The coordinating committees established for the Delaware, Potomac, and Susquehanna Rivers. These were all organized to develop long-range plans including authorization of specific projects to implement the plans with the Corps as both the permanent chairman agency and the agency having responsibility for the ultimate report.

f. Joint studies in which two agencies each have equal responsibility for reporting - as in the Corps-Department of Agriculture Studies of Gering Valley and of Salt Creek in Nebraska - with each agency issuing separate but coordinated reports.

5. A detailed analysis of the workings, effectiveness, and problems of these coordination efforts is beyond the scope of this paper. All of these coordination groups represent essentially the same kinds of interests - Federal agencies, States, and in different degrees the interested citizens - in each study area. Differences in detail are mostly related to and result from differences in the nature of local situations. Any attempt to impose a standard or stereotyped solution on all basins would consequently probably be unwise, at this time.

6. The assigned subject of this paper is Coordination Procedures. However, considering the foregoing and because the expansion in outlook toward this kind of planning has been rather drastic in recent years, it might be more productive to go back a few steps and attempt to clarify some fundamentals that continue to cause difficulty in the field.

7. What is "Coordination?" Interpretations of this function range from standing back out of the way and letting participants individually determine the extent of their contributions, to autocratic detailed direction of all participants. Dictionary definitions are of little help. In the interests of common understanding of the function in the context of this particular subject the following definition is suggested:

> Concentration of the knowledge in many and diverse specialized fields into a common effort to find the best way of using a specific water resource in the public interest.

8. Why Coordinate? Where there is a lack of understanding of the real significance of coordination superficial reasons are likely to be:

a. Because we have been directed to do so. The flood of policy and guidance material that has been issued and which is really intended to create basic understanding of the problem is sometimes taken, by curious inversion, to be specific direction to be applied rigorously and automatically whether appropriate in each case or not. Worse yet, because much of it is what might be called verbose generality it is often scanned casually and filed away for posterity. (See page 466.)

b. To recognize the prerogatives of other agencies. This reaction reflects overconcern with bureaucratic vested interests which, while important in the conduct of our affairs, are in themselves relatively unproductive. Such overconcern with jurisdiction can lead to unnecessary and delaying coordination. Coordination should be selective and limited to agencies having responsibilities pertinent to the problem at hand. (See page 467.)

Reasons for coordination of a more valid nature are:

c. To make use of all pertinent knowledge. This answer flows from the definition in the preceding paragraph. Truly comprehensive planning requires the application of expertise in a vast array of specialized fields ranging from Agronomy to Zoology. No one agency has all the necessary capability. All agencies acting in concert do. (See page 468.)

d. To get participation and understanding of non-Federal interests. Any long-range basin plan will have a major effect on the future and well being of the basin's citizens. No such plan will be carried out without their concurrence. The subject is

complex, technical, and beyond the unassisted purview of the general public. In order to form intelligent judgments on proposals, the public must attain an understanding of at least the salient features of the proposals. This can most effectively be achieved by a planned program extending over the entire study period, during which public understanding can be built - increment by increment - and repetition after repetition. Effective public communication is a subject on which we all have much to learn. Unless we can learn to match our competence in planning with equal competence in public communication, using professional assistance where appropriate, we must consider our job incomplete. (See page 469.)

9. Coordinate with whom? A coordinating committee for water resource planning will include some members who will actually participate in the study to the extent of producing parts of it. The committee will also include members who are advisors rather than participants. The distinction will differ with the circumstances in each case and may in some instances such as Inter-Agency Basin Commissions be completely absent. This distinction is pointed out here merely to clarify functions and not to imply any difference in quality of membership. For studies such as the Delaware, Potomac, and Susquehanna Rivers the following is typical:

a. Participating Members

Corps of Engineers

Department of Agriculture-representing

Soil Conservation Service

Forest Service

Economic Research Service

Department of Health, Education and Welfare-represented by

Public Health Service

Department of Commerce-representing

Bureau of Public Roads

Weather Bureau

Area Redevelopment Administration

Office of Undersecretary for Transportation

Department of Interior-representing

Geological Survey

Fish & Wildlife Service

Bureau of Mines

National Park Service

Bureau of Outdoor Recreation

Federal Power Commission

Housing and Home Finance Agency-representing

Community Facilities Administration

b. Advisory Members:

Representatives of each State concerned.

Representatives of major cities.

Non-Federal Regional Commissions.

10. What makes for a good Coordination Job?

a. Participating members must have:

1. Definite and common goal.

2. Clear assignments.

3. Clear schedule.

4. Adequate funds provided on schedule.

b. Participating members should be required to:

Report on progress in open meetings at frequent intervals.

c. Both Participating and Advisory members should have an opportunity to review and comment on each others work especially in overlapping fields, and should join together in special work groups when appropriate.

d. Advisory members should have frequent opportunity to express their views.

e. Provide a means for keeping Public advised:

1. Publicity.

2. Open meetings of coordinating committee.

3. Bulletins and Brochures.

4. Local organizations.

5. Hearings.

f. Firm direction by Chairman Agency:

1. Keep the effort directed at the main goal.

2. Eliminate duplicate effort.

3. Establish ground rules, format, and single set of basic data.

4. Maintain harmonious relations at the working level in day to day activities. (See page 470.)

5. Demonstrate respect for competency of each agency and its people in their field.

6. Have the fortitude on occasion to make arbitrary decisions for the group.

11. There are some points of comparison between the coordination procedure for the Delaware and Potomac studies and those in prospect for the Susquehanna study that may be useful to consider:

a. The freedom of choice between "inside" as against other agency performance of some parts of report has, since the Delaware report was in preparation, been progressively restricted by clearer definition of other agency interests. Correspondingly, however, the capability of other agencies to furnish assistance is improving. The overall effect should eventually be greater competency obtained at a cost of more coordination.

b. In the Delaware study, Committee meetings open to the public were held at different locations throughout the basin. Local public attendance at these meetings ranged from about 25 to 100, and individuals were permitted to ask questions or to comment. This was an effective communication link with the public which was further augmented by local press coverage. Meetings of the Potomac Committee were in contrast not open to the public. After considering the two experiences it has been decided to conduct open meetings for the Susquehanna study.

c. Toward the end of the Delaware and Potomac studies a series of so called "Hearings in Reverse" were held by the District Engineer to explain the final plan being prepared. The Delaware hearings were well received while those on the Potomac were the source of much criticism arising mainly from previously established opposition and otherwise a general misunderstanding of our purposes.

d. In both the Delaware and Potomac there were several auxiliary organizations that were effective in special fields:

1. Delaware:

(a) Delaware River Basin Advisory Committee - to keep Governors of the four Basin States and Mayors of New York City and Philadelphia advised of developments.

(b) Water Resources Association - privately funded for dissemination of information to the public - publish periodic bulletins.

2. Potomac:

(a) Interstate Commission on the Potomac River Basin - established water quality standards.

(b) Coordinating Committee on the Potomac River Valley - a citizens' group formed in 1957.

(c) Citizens Council for a Clean Potomac - sponsored a series of "Hearings in Reverse."

12. The next job in Coordination. At the risk of repetition of the substance of paragraph 8d, it is suggested that an organized effort be made to improve our skill and techniques in explaining resource plans to the general public. (See page 471) The people in a basin are the final judges as to acceptance or rejection of proposed plans. While we have neither desire nor capability to force acceptance of any plan, we do have an obligation to ourselves and to the participating agencies to insure that public decisions on such plans are made on the basis of wide-spread and accurate understanding of the benefits, detriments, costs, as well as the consequences of doing nothing. In amplification of the point there is inclosed an article "Looking Around" by Rex F. Harlow. This is an illuminating compendium of information on communication techniques. This article will suggest even to the casual reader that in many of our efforts at public communication we have pursued courses that, to put it kindly, were the ones least likely to succeed.

2 Incls: References (Pages 466 through 471)
Article (Pages 472 through 477.)

THERE IS NO DAMN REASON FOR IT

IT'S JUST BAD POLICY

PEACE PEACE PEACE
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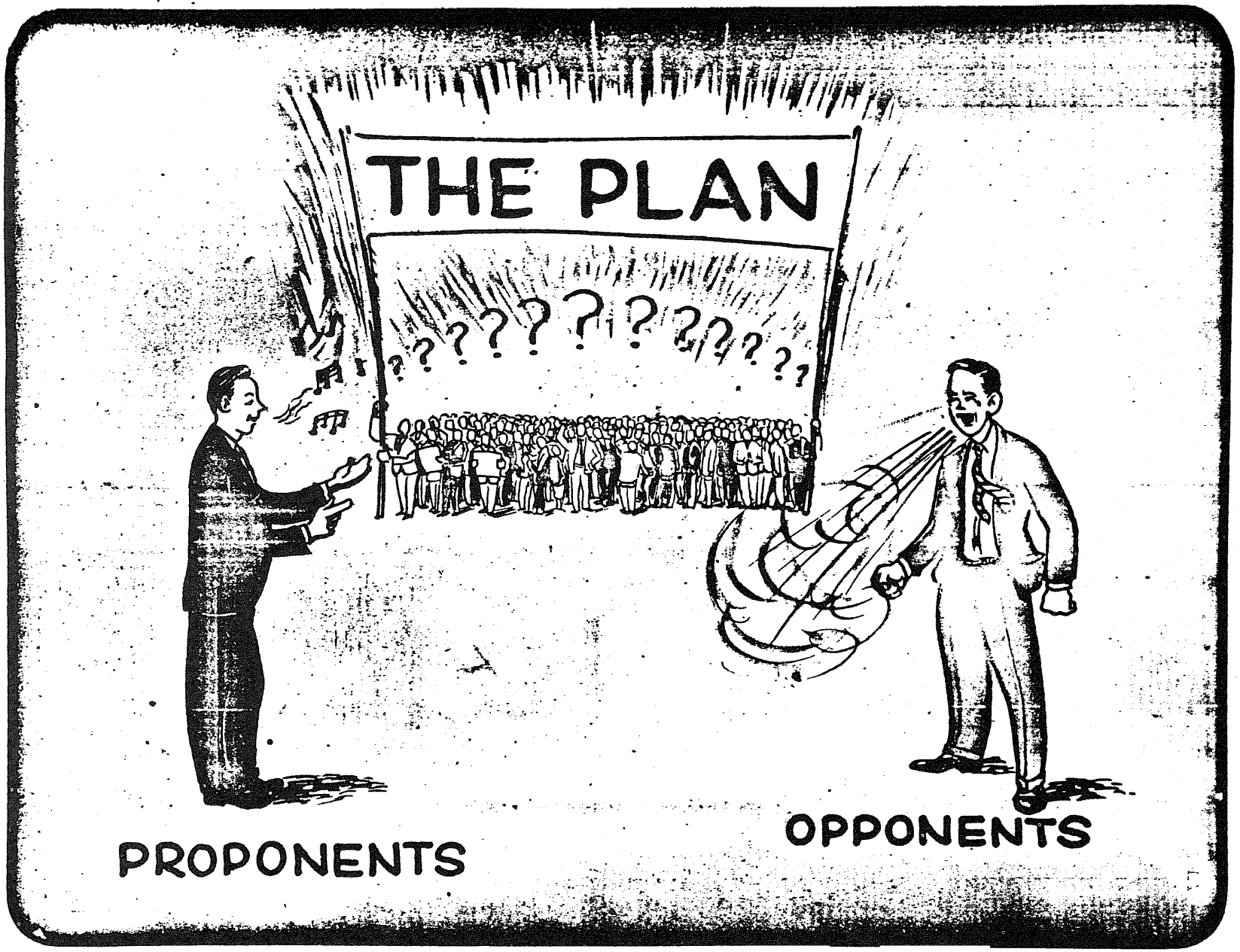
TECHNICAL COORDINATION

A Agriculture, Agronomy
B Botany, Beach Erosion, Biology
C Communication, Climate, Concrete, Coal
D Dredging
E Economics
F Forestry, Fish
G Geology, Groundwater
H Hydrology, Hydraulics, Health
I Imagination, Ideas, Ichthyology
J Judgment
K Knowledge
L Limnology, Local Interests
M Mathematics, Meteorology
N Navigation
O Oysters, Oil
P Power, Potamology, Pollution
Q Quarrying, Quality Control
R Recreation
S Sanitary, Structural, Surveying, Soils
T Transportation
U Urban Planning
V Vegetation, Verbalism
W Wildlife, Water, Waste, Writing
X X-Ray and Radiation
Y Yachting
Z Zoology

PUBLIC COORDINATION

A Acceptability
B Benefits
C Cost
D Detriments
E Effectiveness
F Flexibility
G Goals
H Hopes
I Information
J Judgment
K Knowledge
L Local views
M Motives
N No
O Opposition
P Prejudice
Q Quality
R Restraints
S Support
T Taxes
U Understanding
V Vanity
W Wants
X Unknowns
Y Yes
Z The last word


THE PLAN
PROPONENTS
OPPONENTS

Looking Around

¶ Without a sound communications system a top executive is lost. He must communicate his ideas and feelings, his purposes and goals, his whole personality. Otherwise he and his company pay a heavy penalty. However, many top executives find the art of communicating both difficult and elusive. They can go so far as to think they have mastered the "six honest serving men" of Kipling's *Just-So Stories*: *What, Why, When, How, Where,* and *Who,* only to find that one or more of these serving men elude them. How can they gain a clear understanding of the scientific factors that comprise and control the process of communicating?

As practical, hardheaded men, business executives are demanding information that is to the point, down-to-earth, and directly applicable to their work. They feel they have neither the time nor the inclination to deal in theory, regardless of how interesting and informative it may be, how much it will add to their cultural resources; and they pride themselves on this approach to life, which they have found pays off at the cash register, in prestige, in comforts and satisfactions, and in many other ways.

Accordingly some are enrolling in special communication courses offered by colleges and universities. Others are setting up communication courses and clinics within their own organizations. Still others are attending management conferences devoted to communications analysis and discussion. But by far the greater number are depending on the reading of books like Robert L. Shurter's *Written Communication in Business,*[1] Keith Davis' *Human Relations in Business,*[2] or others for ideas on communication.

Only a few businessmen have turned to the social sciences for help, although many of the surveys and research studies that are constantly being conducted by social scientists the world over bear directly on communication problems of the top executive and can be of great value if he will only glean from them the findings that apply to his specific needs.

The psychologists, the sociologists, the anthropologists, the economists — in fact, almost all social scientists — have long been concerned with communication as one of the great factors in human existence. They have examined it from many angles; they have tested its laws and uses on numerous fronts; they have studied it singly and in groups. Out of all their study and research certain principles and practices stand out as applicable to the communications needs of top executives. These principles seem to me to have great potential importance, as I have indicated in my book *Social Science in Public Relations.*[3] I shall discuss some of the more significant ideas in this article.

* * *

One of the biggest errors the top executive makes, social scientists point out, is to take for granted that others understand what he says. He assumes that they use words just as he does. He does not know how often they miss what he says, how often he fails to convey his meaning accurately. Words, ideas, gestures, signs, symbols, none of these mean the same to others that they mean to him. Yet much of the time he blithely assumes that they do, and risks his welfare on the assumption that his personality, plans, and purposes are being surely, safely, and effectively communicated.

It is interesting to speculate

[1] New York, McGraw-Hill Book Company, Inc., 1957.
[2] New York, McGraw-Hill Book Company, Inc., 1957.
[3] New York, Harper & Brothers, 1957.

why businessmen, who are noted for their shrewdness and skill in dealing with people in other ways, make this error as often as they do (or rather, as often as social scientists think they do). Perhaps one reason is that they simply do not *realize* the extent of poor communication. Time pressures, poor "feedback," and other factors may have blunted their awareness.

Wilbur Schramm, editor of *The Process and Effects of Mass Communication,*[4] explains the problem this way. In the process of communicating we take the information or feeling we want to share and put it in a form — a code — that can be transmitted. To complete the act of communication the message must be decoded, and there is good reason for us to wonder whether our receiver will really be in tune with us, whether our message will be interpreted without distortion, whether the "picture in the head" of the receiver will bear any resemblance to that in our head. For one thing, we can encode and the receiver decode only in terms of the experience each of us has had. Another more subtle cause of trouble is that far more stimuli come to the listener than he can notice; the speaker's words are usually competing with irrelevant thoughts and impressions. How often do we have the undivided attention of the person we are talking to?

The top executive who is a successful communicator recognizes and is influenced by these factors, say the social scientists. He approaches his communications task by considering the best way to reach his audience. What are the people "out there" like? What are their backgrounds, their interests, their needs, their problems, the pressures under which they work, their jobs? What jobs do they prefer? What are their hopes and aspirations? He tries to organize, classify, and otherwise place them in terms of their psychological, social, and economic characteristics. He also considers them by localities, regions, and other geographical subdivisions; by age, race, religion, and politics. He regards the experiences they have had. In short, he tries to answer these questions:

- Who are they?
- What are they?
- What do they do and want in life?
- In what ways do their attitudes, opinions, beliefs, and actions affect the enterprise?

Writing in the October 1955 issue of the *Public Relations Journal,* G. Edward Pendray [5] makes two general observations about people which should help the top executive in his communication efforts:

(1) People are interested first in people, then in things, last in ideas. If an abstract idea — or thing — is what you have to exploit, you will fare best if you state your case in terms of people.

(2) People can be counted on to act only when they expect to gain something by it. Appeals to ideals or altruisms sometimes work, but for sure-fire results spell it out in terms of "what's in it for me."

These maxims need not be followed literally. The findings of Darrell Blaine Lucas and Steuart Henderson Britt in their extensive researches as reported in their book, *Advertising Psychology and Research,*[6] reveal many interest incentives, such as the basic human urges, that have universal appeal and are dependable for attracting large audiences.

Everyone, for instance, is interested in such basic drives as the urge to survive. An appeal to this interest need not be explicit. Similarly, a broad range of news events can arouse the interest of many people, even though they do not stop to analyze how a particular news event relates to their welfare. Many of the appeals to human interest — to the interest in a horse, a fisherman, a ball player, babies, or a boy and his dog — may come very close to basic human urges.

Other interest incentives mentioned by Lucas and Britt are past experience and education, the unknown and the unusual, and the familiar. Every important experience in the background of an individual becomes the basis for an interest incentive, they believe.

* * *

William James stated a well-known, simple law of psychology which has deep communications significance for the top executive: any object not interesting in itself may become interesting through association with an interesting object. The two associated objects grow together, so to speak. The interesting portion sheds its quality over the whole; thus things not interesting in their own right borrow an interest that becomes as real and as strong as that of any natively interesting thing.[7]

In applying this law, the top executive can begin by appealing to the native interests of his publics — ideas they like, things they hold dear. Next, step by step, he can connect with these familiar interests the new points that he wishes to make. He can associate the new with the old in a natural and telling way, so that interest is gradually aroused in his entire point of view. Thus:

An executive may have to overcome prejudice against the size of his company. Many persons are afraid of size because of the power it represents. They think no company should be permitted to get so big that it can "control the lives" of a great many employees, suppliers, and others dependent on it for their income and welfare. What is the

[4] Urbana, University of Illinois, 1954; see pp. 1–26.

[5] "The Folklore of Public Relations," p. 18.

[6] New York, McGraw-Hill Book Company, Inc., 1950.

[7] *Talks to Teachers* (New York, Henry Holt and Company, Inc., 1915).

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— directly, with the facts, which are favorable to bigness, or indirectly, letting the facts speak through performance?

The "association method" will help the top executive solve his problem. Knowing his audience's interest in creature comforts, modernity, shiny new gadgets, and the like, he will speak favorably of the products and services his company offers at low prices, referring only indirectly to the evident fact that nothing but a *big* company, with plenty of capable manpower and money, could accomplish this feat. He will trade on the interest in big achievements and on the pride in our nation's unequaled accomplishments in field after field, to show how his company is in the forefront of progress, a leader in its own field — because it has the resources (size, manpower, management skill, technical talent, and money) to occupy that coveted position.

Finally, he will be careful not to emphasize size as such. Instead he will emphasize such desirable values as extensive research, improved working conditions, and the like — all products of the size of his fortunate company.

In appealing to people's interests it should be kept in mind, however, that people want not only to be informed but also to be satisfied. The latter is sometimes valued more highly than the former, Bernard Berelson points out in a chapter on "Communication and Public Opinion" in *The Process and Effects of Mass Communication*.[8] The effectiveness of communications as an influence on public opinion varies with the nature of the *people*. The stronger people's predispositions are on a given issue, the more difficult it is to convert their opinions; the strongly disposed actually manage not only to avoid contrary communications but also to misunderstand such material when confronted by it. Contrariwise, the less informed people are on an issue, the more susceptible they are to influence.

A proxy fight illustrates the points Berelson makes. The opposing forces who seek control of the company will have their staunch supporters from the beginning. And these will be disposed to listen only to the facts and arguments presented by their side. They will likely see and hear only what they want to see and hear. And they can be counted on to misinterpret or even warp the messages of the opposition. How the top executive marshals his facts and arguments, what media he uses, and when he speaks and carries on his campaign with the uninformed public may well determine success or failure for his side, even though the ultimate decision as to which side gains control of the company will rest with the stockholders.

All of this argues for promptness in getting one's messages over to the public when certain people's predispositions are, or are likely to be, strong. If the top executive "can get there fustest with the mostest" information, ideas, and suggestions, he has a chance of winning over to his side the less informed part of the public. He could learn a lesson from the unions, who usually run away with public sympathy when a strike is imminent or involved. They are not too conservative, stuffy, or legalistic-minded to fight out or present their cause quickly in the press, over the radio or television, and the like. Management "pays through the nose" because it does not take the sensible course of telling its side of the story honestly and promptly.

As for those of the public who have already formed views and prejudices, they will have to be handled differently. All sorts of devices and efforts will need to be resorted to in "reaching through" to their minds and hearts, in holding in check their opposition even if their support cannot be won. If the need of the top executive is to change an attitude, he faces an difficult task. Once established, an attitude has a way of proving — or trying to prove — that it is accurate and justified, social scientists say. People who have an attitude can always find evidence to support it. In fact, as cited above, they do not often look for opposing evidence; it is so much more comfortable to live with the attitude they have. Change is seldom easy, frequently painful.

With references to the kinds of *conditions* that affect communications as an influence on public opinion, Berelson finds that many mass communications on controversial issues have to make their way in a competitive situation — under conditions in which alternative proposals are also available in the media.

Berelson's findings are a warning to the top executive that he must be extremely careful in selecting the content of his communications and the manner in which he distributes them when competing with opposing groups for the public's loyalty. People distrust a person or an organization with an obvious axe to grind. They tend to resist messages that smack of selfish propaganda. They dislike exaggeration and boasting. It is easy to see, therefore, how an indirect content and approach can frequently win more acceptance and support for an idea or a cause than a hard-hitting content and a direct-attack approach.

It is also wise to transmit information in small units, suggests Mason Haire in *Psychology in Management*.[9] A large organized mass of material tends to threaten the listener's or reader's existing patterns and so may be rejected. On the other hand, small units, transmitted little by little, carry the same message over a period of time without the same likelihood of rejection. Cumulatively they may effect the change where they

[8] Wilbur Schramm, op. cit., p. 342.
[9] New York, McGraw-Hill Book Company, Inc.; 1956.

would be rejected out of hand if they were presented all at once.

* * *

Sometimes people think they want facts, but what they actually seek are the opinions of others — opinions that bolster their own views. Mostly they admit into consciousness only those things which interest and promise to benefit them. They exclude those things they do not like or want.

Samuel Stouffer and associates report their findings in the monumental two-volume study, *The American Soldier,*[10] to the effect that facts alone seldom, if ever, move people to action. The scientists conducted extensive research on the American soldier in the Second World War. The soldiers had been presented with factual arguments intended to improve their attitudes and behavior toward the United States and their officers. The researchers found no improvement. Facts increased the *information* of the soldiers, but did not improve their attitude toward country and officers, nor bring more patriotic behavior.

Any successful salesman knows that facts can very rarely stand up against skillful emotional appeal. Be a product ever so good and the facts in its favor incontrovertible, nevertheless unless it is presented in terms of the interests, needs, and service purposes of a prospect — unless clothed with emotional appeal — it has little chance against even an inferior product that is presented in such a way as to catch the fancy. Thus the social scientists are right when they say that the reliance people think they place on facts alone is only a delusion. Instead of building their lives on facts, people build them on assumptions.

Facts do have their place, of course. When the top executive uses them to bolster emotions, they are a powerful aid to his program in supplying people with a welcome justification for their decisions; and when he bolsters facts with emotional appeal, they can be very effective, too. But when he attempts to use facts alone in an effort to change people's attitudes, he is almost surely doomed to failure.

* * *

The Yale Communication Research Program has found out much about learning techniques that is relevant to top-executive communications. Some of the more significant findings appear in *Communication and Persuasion,* by Carl Hovland, Irving Janis, and Harold Kelley.[11]

The Yale scientists say that the opinions of people, like their habits, tend to persist unless they undergo some new learning experience. Regardless of the source and nature of the communication they hear, unless they learn something from it, unless it induces them to accept a new opinion, they are not likely to attach too much importance to it or to change the opinion they already have.

For example, people may be willing to change from potential customers into active ones, to thinking in a new way about the top executive's company, *if* the suggested new way of thinking and acting *is shown to be to their advantage.* When they ask themselves the question, "How much better for me is this new way of thinking than the way I have been thinking?" and they measure the two ways side by side, the conclusion will need to be clearly in favor of the new way. This calls for clear thinking, clear presentation, and persuasiveness on the part of the top executive — besides a clear understanding of the needs and wishes of the people who are being asked to change their opinions.

Once the attitude and opinions of people are changed, they retain many of them for a considerable period of time, say the scientists. The amount of their retention is dependent on a number of factors that are discussed by Hovland:

(1) People retain more meaningful material better than less well-understood material. Material that stands out is better retained, although the overuse of such material merely for reasons of emphasis can backfire. If too many points are emphasized, they will lose their distinctiveness. (Too much and too continuous use of brass in an orchestration tires the listener.) Similarly, if emphasis is not carefully placed, the wrong points may stand out.

(2) The more completely people initially learn material, the longer they will remember it. Up to about three or four repetitions usually increase attention, but after three or four the effect of additional repetitions is slight. Too frequent repetition is likely to lead to loss of attention, boredom, and disregard of the communication.

(3) In the case of persuasive communication people retain the *conclusions* better than the detailed *arguments* used in support of the conclusions.

(4) Interest influences how well people learn the contents of a communication. There is a tendency for material considered unpleasant to be forgotten more quickly than material considered pleasant. Material which is in line with their beliefs and attitudes is learned more rapidly, and it is retained better. When people either agree or disagree strongly with a position, they are more inclined to remember the communication.

(5) Retention may be affected by the degree to which people are motivated on subsequent occasions to try to recall the material learned. The more cause there is to think back about a message, the better it will be remembered. But incidents that counteract the original learning experience will cause it to be forgotten.

(6) People may be exposed to a communication and accept the com-

[10] Princeton, Princeton University Press, 1953.

[11] New Haven, Yale University Press, 1953.

municator's point of view but after a period of time may revert to their previous attitude. Or they may at first reject the communicator's point of view but after a period of time "come around" to his position. The degree to which they accept a persuasive communication that is attributed to a "prestigeful" source, i.e., one that is respected or trustworthy, tends to be comparatively high at first but gradually declines, whereas the degree to which they accept a persuasive communication attributed to a "non-prestigeful" source tends to be comparatively low at first but gradually increases.

(7) Once the beliefs of people are modified by an effective communication, there will be a tendency for their newly acquired opinions to interfere with subsequent acquisition of incompatible opinions.

* * *

In selecting the techniques he will use in his communicating, the top executive will want to take into account the fundamental psychological law enunciated by David Krech and Richard Crutchfield in their *Theory and Problems of Social Psychology.*[12] This law is: as soon as we experience *any* facts, they will be perceived as organized into some sort of meaningful whole.

Illustrating the operation of this law, Krech and Crutchfield cite an experiment by Solomon Asch in which he separately read two lists of traits to two different groups of subjects and asked for personality descriptions:

The two lists were identical with regard to the traits used but different in the order of succession. For example, one group heard the following list: "intelligent, industrious, impulsive, critical, stubborn, envious." The other group heard the same words, but in reverse order: "envious, stubborn, critical, impulsive, industrious, intelligent."

The descriptions obtained from the two groups of subjects differed markedly, leading Asch to conclude that "when the subject hears the first term, a broad, crystallized, but directed, impression is born. The next characteristic comes not as a separate item, but is related to the established direction." [13]

The astute top executive will not only exercise care to see that his appeal to his audience is in a potent attention-catching form; he will go a step further and see that it accentuates an object or objects which will serve some immediate purpose of his audience. It will entertain them, inform them, offer them a personal or group benefit, make them more comfortable, save or make them some money, or otherwise serve or offer to serve them in a way that pleases them at the moment.

For example, in addressing a message to the employees of his company the top executive will *not* emphasize the values of a profit-sharing plan that will pay them generous sums years hence, however valuable and desirable such a plan is to them and the company. Rather he *will* emphasize the shorter working hours, increased pay, longer vacations, better working conditions — all things the employees can see and feel and benefit from *now*. Such messages can be counted on to attract the desired attention and win the hoped-for approval.

In using all these methods of communicating, the top executive will do well to give weight to the findings of Claude Robinson in his studies of advertising impact on audiences. In the June 1956 *Public Relations Journal* [14] Robinson reported that the more mental work (e.g., reasoning or remembering) you require of a reader or viewer, the less he will register of your advertising message. The principle of mental work, he says, applies to people of all levels of intelligence, not just to 12-year-olds or the mentally defective. How many times in the past month, he asks, have you failed to absorb an idea because the communicator required you to undertake mental work?

In mass communications, the importance of groups and the influence of leaders on the interest and opinions of members of their groups are recognized by social scientists. In their *Personal Influence — The Part Played by People in the Flow of Mass Communications,* Elihu Katz and Paul F. Lazarsfeld [15] report finding in their researches that there would seem to be a "two-step flow of communications" — from the media to opinion leaders, and in turn from opinion leaders to others with whom they are in contact. Leaders show a greater interest than nonleaders. But this greater interest apparently results in leadership primarily when the leader is associated with others who are also interested to some extent, possibly only slightly less than he is.

Thus, as Katz and Lazarsfeld point out, when a top executive communicates with groups, it is important, first, to locate the kinds of groups in which influence transactions take place, and, secondly, to determine in what ways opinion leaders differ from the close associates whom they influence. It will not be enough for the top executive to win over the leaders of the group alone; he will face the desirability of winning other "support" members of the group also, to give the leader the feeling of security he needs. As a wise old United States Senator once sagely remarked, "You can't be a leader without a following."

* * *

These findings and conclusions of social scientists growing out of their researches are but a few of the many that are available to the top executive. But they can serve to remind him that communicating is a difficult and complex but

[12] New York, McGraw-Hill Book Company, Inc., 1948.
[13] Ibid., pp. 86–87.
[14] "The Gentle Art of Persuasion," pp. 3–5, 24.
[15] Glencoe, Illinois, Free Press, 1955.

rewarding task. It requires a keen perception, an eye and an ear carefully attuned to the changing interests, needs, and moods of various publics, and a skillful use of principles, procedures, and tools.

The top executive has people of various types in his organization to help him carry on his communications activities. In fact, most of his communications efforts are in the nature of assignments to others. But the final responsibility for performing this function, as for all the functions of management, rests squarely on his shoulders. He can delegate only so much; beyond that he must carry his burden alone. Both the communicating that he delegates and that which he does himself can be made much more effective — and enjoyable — if he adds to his kit of working tools the basic ideas about communication that are being made known by the social scientists.

In doing this, the executive is in a sense making the social scientists a part of his organization, a wonderfully productive source of help and guidance in fulfilling his communications responsibilities.

How he uses this source, in what manner and degree he learns and applies the communications findings and conclusions of the social scientists, may easily measure the amount and quality of the executive's success. For, to succeed, he must become the master of his trade, and the use of communications constitutes a major, possibly even the most important, requirement of that trade.

— *Rex F. Harlow*

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Report Quality Control

by
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Office of the Chief of Engineers, Washington 25, D. C.

The plans we prepare for development of water and related land resources must meet many criteria some of which can be specified precisely and can therefore be readily checked for conformance. Many aspects of good planning, however, involve assumptions or conclusions which depend largely on judgment. The way such aspects of the planning process are handled may spell the difference between a good plan and a poor one. The procedures for controlling the quality of reports must therefore be adequate to provide checks on the soundness of judgment as well as on conformance to prescribed criteria.

A basic essential for good quality in planning is full understanding by all personnel involved of the standards of quality desired. We try to insure that such understanding can be achieved primarily through issuance of regulations and manuals. Unfortunately, much of the guidance material now in use does not reflect adequately the planning policies and standards of recent origin. It is primarily an OCE responsibility to overcome this deficiency. We hope that one of the results of this seminar will be to equip us to do this quickly and effectively. Despite the current inadequacy of some sections of the manuals, much guidance material or basin planning has nevertheless been made available in the form of letters, conferences and, of course, the new standards in S. Doc. 97. It is essential that all planning personnel become familiar with and understand all such guidance information. Real understanding is particularly important because regulations and manuals primarily provide guidelines for application of thought rather than rigid criteria to be followed blindly. Also, most guidance information is susceptible to gross misinterpretation if it is not fully understood. We all have a job to do in making this quality control tool effective. First of all, OCE must prepare the regulations and manuals so that they are clear, complete and usable. Field personnel should study and discuss guidance data in seminars, briefing sessions, and case analyses to insure that all concerned understand and interpret the instructions consistently. Most field offices have not been backward about suggesting clarification of manuals in the past, and usually they are right as to the need for clarification but too often fail to suggest specific clarifying language.

One of the most important aids to insuring an adequate quality of planning is the plan of investigation or plan of survey. Such plans should be prepared as the first step in any study. They may have to be quite general at first but they can and should be revised and kept up-to-date and realistic as the planning proceeds and as developments occur which were not foreseen or which depended on prior events.

Plans of investigation should be designed to be constantly useful to all personnel at all echelons in all agencies concerned with the planning effort. They are especially needed for complex basin plans where there needs to be mutual understanding by many individuals of what each is doing and when. The quality of the efforts of many will suffer if a related part of the study is not done in the right way at the right time.

Critical path diagrams may be helpful to illustrate the interrelationship of various phases of a study and to indicate where additional effort or speed-up is needed to insure orderly progress. A sample critical path diagram prepared by the San Francisco District was distributed to seminar participants for information.* In this case, very broad job areas only were indicated and both manpower and funds requirements were included in the diagram. Others have used this method in more detail for portions of the sequence of planning events. Manpower and funds requirements may not be needed for application of the method to advantage for certain aspects of a study. One advantage of such diagrams is their effectiveness in illustrating critical operations to those whose decisions may be needed to get proper action on such operations. This type of control is particularly valuable in basin planning where the number of agencies and complexity of operations are such that failure in accomplishment of one or more phases of the study on time may have serious adverse effects on the quality and timing of other phases.

On major, basin-wide studies particularly it is important that conferences of District, Division, OCE and Board personnel be held in the field at the outset of a study, just before it nears completion and at appropriate times in between. The initial conference should be held soon after initial funding. A draft of a plan of survey may well constitute the agenda for this first conference. During the study, conferences should be arranged at times when major decisions have been or are about to be made by reporting officers, as, for example, when needs and objectives are being fully defined, and when selecting projects for detailed study.

In addition we expect to standardize the practice of having one or more representatives of Division and District offices visit OCE annually to review the status of each major comprehensive study.

A major purpose of any of these conferences is to insure that the viewpoints from which each echelon of the Corps must judge various aspects of a plan are considered at all stages, particularly when key decisions are made. OCE and Division personnel cannot and should not do the Districts' thinking for them on any problem, but they can help the Districts by acquainting them with experiences in other Districts and Divisions and with pertinent current information not available to Districts.

For example, the field personnel of the Corps and another agency may be finding it difficult to settle a point because of conflicting policies prescribed by higher offices at a time when the higher offices may be

* See pages 481-484.

approaching agreement on mutually acceptable change in policy or practice. Similarly, personal knowledge by Washington personnel of an inter-agency problem at field level may help bring about discussions and eventual agreement in Washington on policies that will make it easier for field personnel to work together.

In addition to improving each echelon's ability to do its part of the job, conferences afford the opportunity to reach mutually acceptable interpretations of policies, standards, and criteria. Such differences of interpretation, within a single office, between agencies or between echelons of an agency are a major cause of trouble in the planning process. Unless such differences are eliminated or minimized throughout the process, many plans will be found unacceptable for one reason or another at some stage of review--usually at the end, when the damage is greatest and the most time and effort are needed to correct the deficiency.

Some misinterpretations and mistakes can be avoided by correspondence and consultation by phone and these methods should be used when points obviously requiring consultation arise, but conferences should be used to review the situation periodically in order to smoke out things that are not obvious.

The foregoing considerations apply equally to inter-relations within each office of the Corps and among agencies as well as between echelons of the Corps. Our procedures in all these inter-relationships should be designed to promote exchange of ideas and insure mutually acceptable interpretation of objectives, policies, and conclusions.

In summary, these are suggested as important elements of the job of report quality control:

(a) Measures to insure that all planning personnel understand all standards and guidelines and interpret them consistently.

(b) Preparing, keeping up-to-date, and constantly using plans of survey to guide and control the planning efforts.

(c) Conferences to insure that all viewpoints are brought to bear on problems and that objectives and policies are interpreted and applied in a manner acceptable to all concerned.

(d) Earliest possible resolution of possible differences of interpretation.

Attachment, pages 481-484

COMPLETED MANAGEMENT IMPROVEMENT REPORT		REPORTS CONTROL SYMBOL CSCAM-10(R2)
TO: Division Engineer U.S.Army Engr.Div.South Pac. San Francisco, California ATTN: SPDCM	FROM: District Engineer U.S.Army Engineer District Corps of Engineers San Francisco, California	DATE: 30 July 1962 PROJECT NUMBER: SPN 63-4

IMPROVEMENT

Critical-Path Planning & Scheduling for Engineering Survey Reports

DATE INSTALLED

About 1 May 1962

MAJOR ACTIVITY AFFECTED

Civil Works, Engineering and Design

OBJECTIVE

BACKGROUND

In the Survey Report program, the Planning & Reports Branch, Engineering Division, assumes leadership for directing and guiding engineering studies. With initative in Planning & Reports Branch, supporting elements, such as Design and Survey Branches, often find it difficult to properly program branch activities since motivation for survey report studies may be lacking.

BEFORE IMPROVEMENT

Efforts have been made in the past to minimize the above difficulty by monthly or bi-monthly program conference and by use of a monthly progress report.

AFTER IMPROVEMENT

Following the Critical-Path Method of planning and control, this office prepared three-dimensional charts for each survey report for which study funds have been made available. A copy of one such chart currently in use is attached as Inclosure I to this report. The intent of each chart or diagram is to depict broadly each job or activity essential to the survey report from start to finish and to identify those activities critical to the on-time completion of the survey. The charts, in addition to illustrating each activity in sequence of action, also associate those activities with a unit of time and cost. Planning & Reports engineers are responsible for continuous analysis of progress versus schedule and for maintaining and posting the master critical-path charts on a current basis. These P&R engineers in turn assure that up-to-date copies of charts are made available to design, survey, and other engineering staffs concerned in order to afford each a ready picture of the project as a whole and the progress to date.

GAINS

(See other side)

MANAGEMENT SYSTEMS OR TECHNIQUES USED

PERT and Critical-Path Method

INCLOSURES	COMPLETED BY (Name, Title and Organization)
CPM Diagram - Alhambra Creek	E. H. HANDLIN Chief, Water Resources Planning Sec, Planning & Reports Branch, Eng. Div.

ENG FORM 2672 1 DEC 61 EM 1-1-80 REPLACES EDITION OF 1 JUNE 56, WHICH MAY BE USED 473

429331

INS

Improved method of assigning priorities to individual study features relationship to total study program.

More efficient use of available study funds.

Better utilization of engineering personnel.

Eliminates overlooking small but critical operations.

Provides the District Engineer and key engineering personnel with a-glance information on each survey.

CPM charts or diagrams are useful for training and orienting new gineering personnel.

PLANATORY NOTES - ATTACHED CHART

Use of several block shapes to differentiate between organizational elements is bitrary and primarily for the purpose of readily visualizing quantity of work to performed by the several organizational elements. The flow chart revolves about e study coordinator and only the broad functions required to assist him in pre- ration of the final report are delineated. Supplemental flow charts to detail her study efforts could be prepared as found desirable. For example: the flow art through design and cost estimates could be expanded to show details of work rformance.

Estimates of time shown are minimum times for work performance. Critical path ne indicates minimum weeks of work-not duration of study. Fund programming estab- shes calendar time.

Dummy blocks have been inserted to more graphically portray work flow.

"X" indicates unknown time element but less than time required on other production ths to same point.

Notice of Public Hearing must be coordinated with congressional representatives l local officials and then issued 30 days prior to hearing.

EVALUATION STATEMENT

USAEDist, SF
3 May 1963

USE OF CPM FOR PROGRAMMING
ENGINEERING SURVEY REPORTS

1. Critical-path programming for survey reports has been in existence about one year in this District. During that time the system has been applied to ten survey reports. The system was established in some report programs during the initial year and in other reports during the middle of a survey program. In August 1962, a CPM chart was incorporated in a Plan of Survey.

2. When CPM was first considered for survey reports, it was concluded that resultant benefits which could be monetarily evaluated would be substantially less than with a defined program. This conclusion was due to the fact that survey reports are comparable to research and development programs requiring CPM programs involving substantial judgment factors relative to time and cost. It was also concluded, however, that CPM added a new dimension to programming by defining the interplay of study phases and thus would provid a new management tool.

3. Development of CPM for survey reports has indicated that charts should be adequate to define all steps leading to the end product but that phases identified should cover only general areas of accomplishment. It was found that, due to the substantial judgment factors involved, minor details would continually change in scope and related program changes would negate management values. In consonance with this finding, all CPM programs have been prepared assuming unlimited manpower is available but funds and completion dates are fixed in accordance with approved plans of surveys.

4. Areas of management where benefits have appeared are:

a. Report phases have been more fully identified at study initiation. Review of CPM draft has permitted supporting elements to identify required work in early study stages. This phase also indirectly orients new personnel with the scope and complexity of required work.

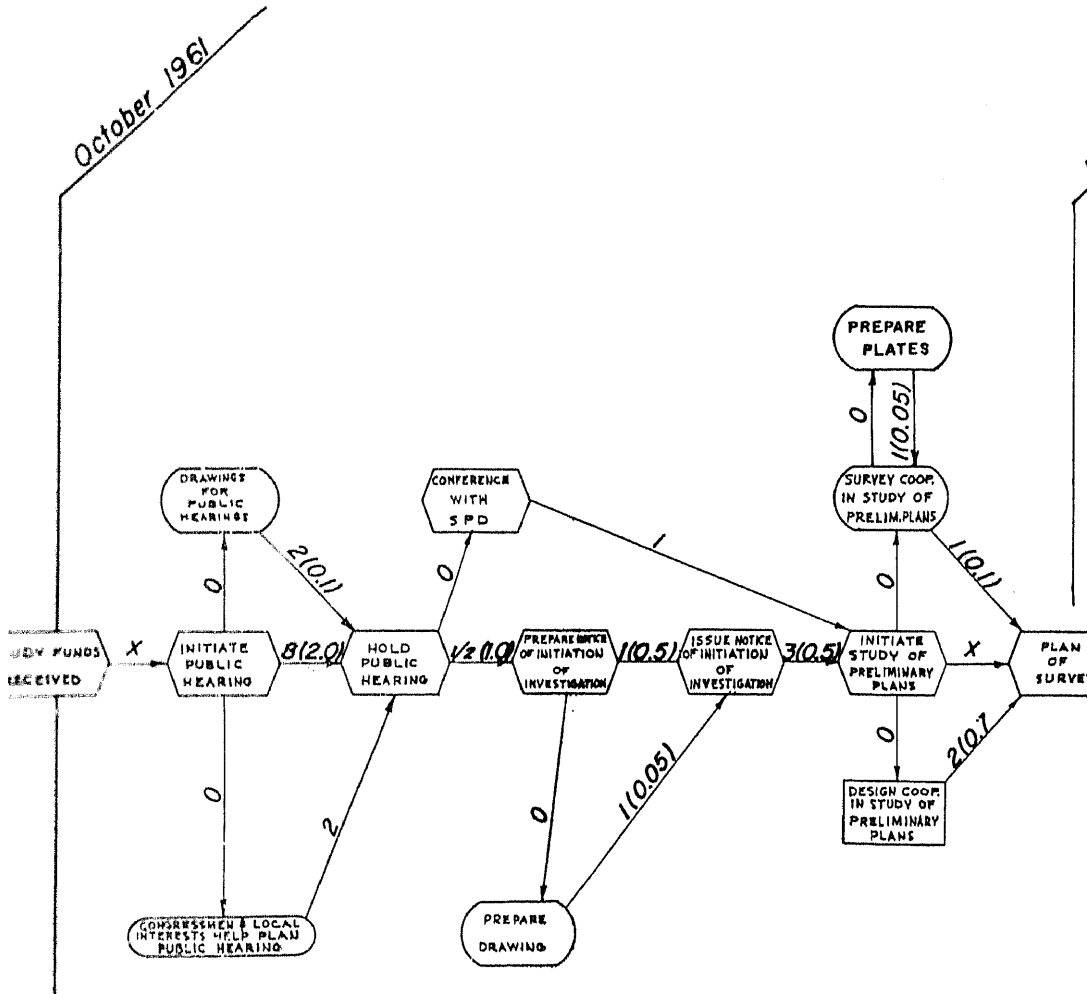
b. Annual funds versus accomplishment is more clearly defined and during the course of a fiscal year suitable revision of phase accomplishment can be made in the event a program study phase encounters a manpower problem.

c. Supporting elements are more cognizant of required coordination with other agencies and timing for such activities.

d. Supporting elements can better evaluate status of time and money for the various projects and thereby improve their work schedules and effect maximum use of assigned personnel.

5. Due to the relatively short time CPM has been used in study programs usually involving two or more years, the full benefit of CPM cannot be completely identified at this time.

U. S. ARMY


October 1961
PREPARE PLATES
0
1(0.05)
DRAWINGS FOR PUBLIC HEARINGS
CONFERENCE WITH SPD
SURVEY COOP. IN STUDY OF PRELIM. PLANS
2(0.1)
1
1(0.1)
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0
UDY FUNDS ECEIVED
X
INITIATE PUBLIC HEARING
8(2.0)
HOLD PUBLIC HEARING
1/2(1.0)
PREPARE NOTICE OF INITIATION OF INVESTIGATION
1(0.5)
ISSUE NOTICE OF INITIATION OF INVESTIGATION
3(0.5)
INITIATE STUDY OF PRELIMINARY PLANS
X
PLAN OF SURVE
0
2(0.7)
DESIGN COOP. IN STUDY OF PRELIMINARY PLANS
0
2
0
1(0.05)
CONGRESSMEN & LOCAL INTERESTS HELP PLAN PUBLIC HEARING
PREPARE DRAWING

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APPENDIX B

List of Seminar Participants
(*denotes part-time participation)

Office, Chief of Engineers

*Lt. General Walter K. Wilson, Jr., Chief of Engineers
*Major General R. G. MacDonnell, Deputy Chief of Engineers
Major General Jackson Graham, Director of Civil Works
Brig. General Howard W. Penney, Deputy Director of Civil Works (Planning)
Lt. Col. C. A. Hays, Assistant Director of Civil Works
Mr. Eugene W. Weber, Deputy Director of Civil Works (Policy)
*Mr. Wendell E. Johnson, Chief, Engineering Div., Civil Works
*Mr. B. J. Tofani, Chief, Programs Div., Civil Works
*Mr. Erwin Reisler, Assistant Chief, Planning Div., Civil Works
Mr. Edgar W. Landenberger, Chief, Project Development Branch, Planning Div., Civil Works
Mr. Russell Morgan, Chief, Basin Planning Section, Planning Div., Civil Works
Mr. Gary Baltis

*Mr. Howard Cook, Chief, Policy and Legislative Branch, Planning Div., Civil Works
Mr. N. A. Back, Chief Economist, Planning Div., Civil Works
*Mr. Donald Curtis, Chief, Multiple Use Coordination Branch, Planning Div., Civil Works
*Mr. Fred Thrall, Assistant Chief, Multiple Use Coordination Branch, Planning Div., Civil Works
*Mr. Walter G. Sutton, Chief, Flood Plains Studies, ARA Section, Policy and Legislative Branch, Planning Div., Civil Works
*Mr. B. J. Witzig, Chief, Legislation and Regulations Section, Policy and Legislative Branch, Planning Div., Civil Works
*Mr. Verle Farrow, Chief, Hydrologic and Hydraulic Section, Engineering Division, Civil Works
*Mr. Dwight Nunn, Chief, Reservoir Regulation and Meteorological Section, Engineering Div., Civil Works

Board of Engineers for Rivers and Harbors

Mr. H. J. Mullaney, Chief, Evaluation Division
*Mr. E. E. Bottoms, Engineering Division
Mr. L. T. Crook, Project Engineer, Engineering Division
Mr. G. H, Kurttila, Project Engineer, Engineering Division
Mr. Floyd Morris, Project Engineer, Engineering Division
Mr. R. D. Murray, Project Engineer, Engineering Division
Mr. R. K. Adams, Civil Engineer, Engineering Division

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Mr. George Watts, Assistant Chief, Engineering Division

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*Mr. Joel Johanson, Budget Examiner
*Mr. W. K Sasaki, Budget Examiner
*Mr. R. H. Teeters, Budget Examiner
*Mr. John Hadd, Budget Examiner
*Mr. J. E. Springfield, Budget Examiner

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*Mr. Gladwin Young, Associate Administrator, SCS
*Mr. Carl Fetzer, Soil Conservationist, River Basin Division
*Mr. Ellis Hatt, Assistant to the Deputy Administrator, SCS
*Mr. Harry A. Steele, Director, Resource Division, Economics Division, Economic Research Service
*Mr. Mark M. Regan, Assistant to the Director, Resource Division, Economics Division, Economic Research Service
*Mr. William Green, Chief of River Basin and Watershed Branch, Resource Development Economics Division, ERS

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*Mr. Edgar Dunn, Deputy Assistant Secretary for Economic Affairs
*Mr. Byron Nupp, Chief, Division of Land Transport, Office of the Under Secretary for Transportation
*Mr. Victor Roterus, Economic Advisor to the Administrator, ARA
*Mr. L. D. Ashby, Regional Economics Staff, B.D.S.A.

epartment of Health, Education and Welfare

*Mr. Keith Krause, Chief, Technical Services Branch, Division of Water Supply and Pollution Control
*Mr. James Flannery, Chief Economist, Technical Services Branch, Division of Water Supply and Pollution Control
Mr. John McLean, Chief, Water Resources Section, Sanitary Engineering Center, Cincinnati, Ohio

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*Mr. Henry Caulfield, Assistant Director, Resources Program Staff
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*Mr. James Stout, Chief, Division of River Basins, Bureau of Power
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Mr. L. G. Feil, Chief, Engineering Division, Kansas City District
Mr. Willis G. Fish, Chief, Planning and Reports Branch, Kansas City District
Mr. K. E. Ristau, Chief, Planning & Reports Branch, Omaha District
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1/ (Paper submitted in conjunction with Mr. B. H. Dodge, NAD)

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Mr. B. H. Dodge, Chief, Planning and Reports Branch, NAD
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*Mr. Robert Gidez 2/, Economist, Basin Planning Branch, NAD
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*Mr. Albert Erickson 3/, Comprehensive Basin Studies Branch, Baltimore District
Mr. H. J.Fine, Chief, Planning and Reports Branch, Norfolk District
Mr. V. V. Lisovitch, Chief, Project Development Section, Philadelphia District
Mr. Frank Panuzio, Assistant Chief, Engineering Division, for River Basin Planning, New York District
Mr. Fred Hubbard, Recreation Specialist, River Basin Planning Branch, NAD

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Mr. Vernon G. Goelzer, Chief, Planning and Reports Branch, Detroit District
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Mr. R. H. Hays, Chief, Engineering Division, Louisville District
Mr. John F. Bruce, Chief, Basin Planning Branch, Louisville District
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Mr. A. B. Davis, Chief, Planning and Reports Branch, Galveston District
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